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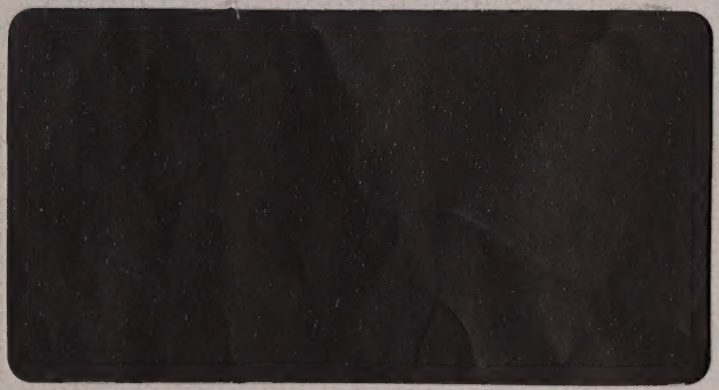

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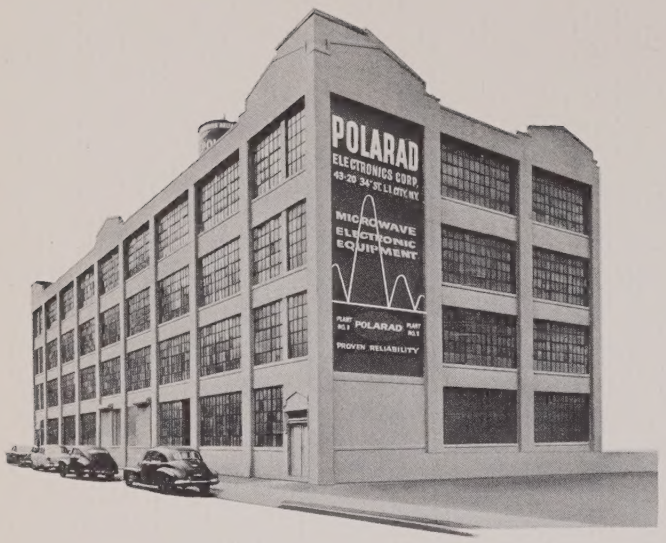

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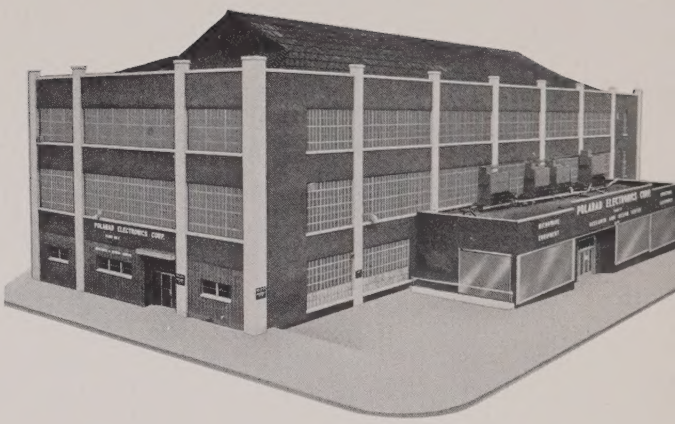

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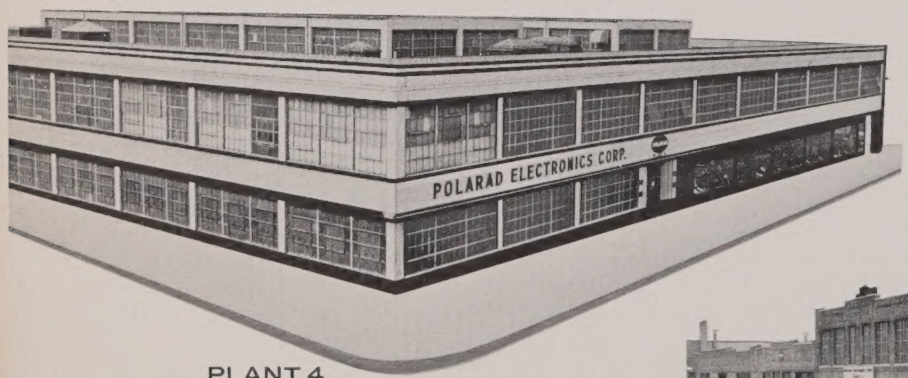

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POLARAD

INSTRUCTION MANUAL

MICROWAVE
SIGNAL GENERATOR
MODEL PMX

RETURN TO
AEROSPACE DIV.

G 48: SERIAL NOS. 182, 183, 185 THRU 189, 191, 194 THRU 217, 219 THRU 225

G 711: SERIAL NOS. 210, 227 THRU 231, 234, 235, 238 THRU 241, 243, 246, 244, 250 THRU 254.

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Polarad Electronics Corporation warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, fuses or batteries, which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which on our examination shall disclose to our satisfaction to have been thus defective.

Polarad Electronics Corporation reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of the Polarad Electronics Corporation, and Polarad neither assumes nor authorizes any other person to assume for them any other liability in connection with the Sales of Polarad's instruments.

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PROVEN RELIABILITY

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WARNING
HIGH VOLTAGE

is used in the operation of
this equipment.

DEATH ON CONTACT

may result if operating
personnel fail to observe
safety precautions.

Be careful not to contact high-voltage connections or any power connections when using this equipment. Turn off the power and discharge all high-voltage capacitors before making any test connections or doing any work inside the equipment.

EXTREMELY DANGEROUS VOLTAGES

exist in the power supply and CRT circuit.

Microwave Signal Generator Model PMX

SECTION 1
INTRODUCTION

1-1. Scope of Manual

This instruction manual contains directions for the use, operation, and maintenance of Microwave Signal Generator Model PMX, designed, developed, and manufactured by the Polarad Electronics Corporation, Long Island City 1, New York.

1-2. Purpose and Use of Equipment

The Polarad Model PMX Microwave Signal Generator is a precision instrument designed to generate cw, fm, square wave, and pulse-modulated radio frequency energy over the range from 4,450 to 11,000 mc in two overlapping bands, using two (G-48 and G-711) precision plug-in tuning units. The Model PMX provides facilities for testing and aligning broad and narrow band microwave systems and components, such as antennas, attenuators, beacons, crystal mounts, hybrid junctions, preselectors, radars, receivers, and rf amplifiers. Specific measurements that can be taken with this equipment include, antenna gain, frequency, image rejection, power gain, selectivity, sensitivity, signal-to-noise ratio, SWR, and transmission line characteristics.

1-3. General Description

The Model PMX Microwave Signal Generator is a versatile instrument which combines high accuracy, simplicity of operation, and portability. The tuning assembly of this equipment utilizes two separate and removable plug-in tuning units which are interchangeable. Tuning Unit G48 covers the frequency range from 4,450 to 8,000 mc and Tuning Unit G711, the 6,950 to 11,000 mc frequency range. A broadband external cavity klystron oscillator enables continuous tuning over the complete frequency range of each tuning unit. Each tuning unit plugs into the basic unit, which also contains the modulator, keyer, and the electronically regulated power supplies. This method of construction facilitates servicing and alignment procedures.

The Polarad Model PMX is housed in a sturdy, louvered aluminum cabinet which presents a neat and pleasing appearance. The internal components of the Model PMX are cooled by a blower fan, contained on the basic unit, to ensure reliable operation and longer life for components. The complete equipment is ruggedly constructed to operate dependably through extreme climatic and environmental conditions.

1-4. Technical Characteristics

Power Input . . . . 115v-230v ±10%, 50-60 cps, 300 watts.

Frequency Range and Accuracy . . . Tuning Unit G48: 4,450 to 8,000 mc, ±1%.
Tuning Unit G711: 6,950 to 11,000 mc, ±1%.

Power Output . . . 1 milliwatt (0 dbm) calibrated.

Attenuator Output Range . . . . . 0 dbm to -127 dbm, 0.223 volts to 0.1 microvolt.

Attenuator Output Accuracy . . . . . ±2 db from 0 to -127 dbm (with correction chart).

Output Impedance . . . . . 50 ohms nominal.

Output VSWR:
G-48 . . . . . 2.1:1 max.
G-711 . . . . . 2.5:1 max.

Output Connector . . . . . Type N.

Modulation . . . . . Internal or external pulse, square wave or fm.

Internal Pulse Modulation:
Width . . . . . 0.2 to 10 microseconds.
Repetition Rate . . 10 to 10,000 pps.
Delay . . . . . 2 to 2,000 microseconds.
Sync . . . . . Internal, external pulse or sine wave.
Rise Time . . . . . 0.1 microsecond as measured between 10% and 90% of maximum amplitude of initial rise.
Decay Time . . . . 0.1 microsecond as measured between 10% and 90% of maximum amplitude of the final decay.

Int. Square Wave:
Rate . . . . . 10 to 10,000 pps.
Symmetry . . . . . ±10%.
Sync . . . . . Internal.

Internal FM:
Type . . . . . Linear sawtooth.
Frequency Deviation . . . . . 5 mc minimum.
Rate . . . . . 10 to 10,000 pps.
Sync . . . . . Internal, pulse or sine wave.

External Pulse Modulation:
Polarity . . . . . Positive or negative.
Rate . . . . . 10 to 10,000 pps.

Pulse Width . . . . 0.2 to 100 microseconds.
Amplitude . . . . . 10 to 40 volts peak.

Output Sync Pulses:
Polarity . . . . . Positive, delayed or undelayed.
Rate . . . . . 10 to 10,000 pps.
Amplitude . . . . . 15 volts peak minimum.
Rise Time . . . . Less than 0.25 microsecond.

External Sync:
Type of Input . . . Positive, negative or sine wave.
Amplitude . . . . . Pulse: 5 to 50 volts peak; Sine Wave: 5 to 40 volts rms.

1-5. Electron Tube Complement

Table 1-1 lists the various tubes used in the Model PMX Microwave Signal Generator. Refer to figures 4-3, 4-5, 4-6, and 4-8 for the location of these tubes.

TABLE 1-1. ELECTRON TUBE COMPLEMENT

Ref. Symbol	Tube Type	Function
V1	5R4GY	Rectifier
V2	5R4GY	Rectifier
V3	5933	Series Regulator
V4	12AX7	DC Amplifier
V5	5651	Voltage Regulator
V6	5651	Voltage Regulator
V7	5R4GY	Rectifier
V8	6AR6	Series Regulator
V9	12AT7	DC Amplifier
V10	5651	Voltage Regulator
V11	0A2	Voltage Regulator
V12	0A2	Voltage Regulator
V13	5Y3	Rectifier
V14	6AR6	Series Regulator
V15	12AX7	DC Amplifier
V16	0B2	Voltage Regulator
V17	5Y3	Rectifier
V18	6080	Series Regulator
V19	12AX7	DC Amplifier
V20	0A2	Voltage Regulator
V101	6X4W	Protective Diode
V102	*	Klystron Oscillator
V103	6X4	Rectifier
V104	6AR6	Series Regulator
V105	12AX7	DC Amplifier
V107	6AH6	Amplifier
V108	6CL6	Amplifier
V201	5725	Phantastron Rate Generator
V202	12AU7	A - Coupling Amplifier B - Coupling Amplifier
V203	5725	Phantastron Rate Generator
V204	12AT7	A - Cathode Follower B - Buffer Amplifier
V205	5725	Delay Phantastron
V206	5687	A - Blocking Oscillator B - Delayed Sync Blocking Oscillator
V207	12AT7	A - Phase Inverter B - Clipper Amplifier
V208	12AU7	Schmitt Trigger
V209	5687	A - Puller Amplifier B - Undelayed Sync Blocking Oscillator
V210	12AU7	Cathode Follower
V211	6AN8	Width Multivibrator
V212	6AH6	Phase Inverter

*Tuning Unit
G-48 - Tube Type - 5721 or QKK823
G-711 - Tube Type - ZV1011

1-6. Accessories Supplied

The following accessories are supplied with the Model PMX Microwave Signal Generator.

1 - AC line cord	Part No. B111144
1 - RF cable	Part No. BP12551
1 - Video cable	Part No. BP12553

SECTION 2
OPERATION

2-1. Function of Controls

Haphazard operation or improper settings of the controls can cause damage to this instrument. Therefore, it is important to know the function of every control, indicator, and connector before energizing the equipment.

Familiarization of the operator with these items will ensure accurate and reliable performance. Table 2-1 lists the front panel designations, of operating controls, indicators, connectors, and their functions. Refer to figure 2-1 for the location of the above.

Figure 2-1. Microwave Signal Generator Model PMX, Front Panel

TABLE 2-1. OPERATING CONTROLS AND FUNCTIONS

Controls, Indicators or Connectors	Function
POWER INPUT 115/230V 50-60 CPS	Connects signal generator to 115v-230v 50-60 cps source. (At rear of dust cover).
POWER ON-OFF switch	When in ON position applies ac power to the instrument.
POWER indicator	Glows when the POWER ON-OFF switch is on ON position.
MODULATION SELECTOR switch	Permits selection (internal or external) of cw, fm, square wave or pulse modulated output.
ZERO SET control	Permits balancing of the internal thermistor bridge so that the POWER SET meter indicates ZERO.
POWER SET meter	Indicates when proper adjustment of the external klystron cavity is achieved.
POWER SET control	Permits adjustment of the external klystron cavity so that the POWER SET meter indicates POWER SET.
SIGNAL FREQUENCY control and FREQUENCY IN MEGACYCLES dial	The control sets the desired frequency which appears on the FREQUENCY IN MEGACYCLES dial.
R. F. ATTENUATOR control and ATTENUATION -DBM dial	Reduces the rf output voltage to known levels below a measured reference level as indicated on the ATTENUATION -DBM dial.
R. F. OUTPUT connector	Connects the rf output from the attenuator to the equipment under measurement.
SYNC & POLARITY SELECTOR switch	INT. MOD. & SQ. WV. position: a. Allows FREQUENCY CYCLES PER SECOND control to control the modulation repetition rate when MODULATION SELECTOR switch is in FM, INT. SQ. WV. or INT. PULSE positions. b. Permits use of DELAY MICROSECONDS, FREQUENCY CYCLES PER SECOND, and PULSE WIDTH MICROSECONDS controls when MODULATION SELECTOR switch is in INT. PULSE position. c. Permits use of FREQUENCY CYCLES PER SECOND control when MODULATION SELECTOR switch is in INT. SQ. WV. position. SINE + or - positions: a. Repetition rate for modulation of the klystron repeller is determined by an external positive or negative pulse or sine wave. b. Permits use of the DELAY MICROSECONDS and PULSE WIDTH MICROSECONDS controls when MODULATION SELECTOR switch is in INT. PULSE position.
DELAY MICROSECONDS and MULTIPLIER controls	Permits adjustment of the delay between the rf output pulse and the undelayed sync pulse over the range from 2 to 2,000 microseconds, but not greater than 75% of the pulse period, as shown in figure 2-2.
FREQUENCY CYCLES PER SECOND and MULTIPLIER controls	Determines the modulation repetition rate when the SYNC & POLARITY SELECTOR switch is in INT. MOD. & SQ. WV. position.
FM AMPLITUDE control	Sets the magnitude of the sawtooth signal applied to the repeller of the reflex klystron oscillator when MODULATION SELECTOR switch is in FM position.
PULSE WIDTH MICROSECONDS control	Permits adjustment of the rf pulse width from 0.2 to 10 microseconds when MODULATION SELECTOR switch is in INT. PULSE position.
EXT. SYNC and MOD. connector	Permits the signal generator to be connected to a source of external modulating voltage for the klystron repeller when MODULATION SELECTOR switch is in EXT. MOD. position and SYNC & POLARITY SELECTOR switch is in SINE + or -, depending on the polarity of the external signal.

TABLE 2-1. OPERATING CONTROLS AND FUNCTIONS (Continued)

Controls, Indicators or Connectors	Function
UNDELAYED SYNC. OUT connector	Permits a positive trigger pulse to be connected to the signal generator which leads the rf pulse in time when MODULATION SELECTOR switch is in FM or INT. PULSE positions.
DELAYED SYNC. OUT connector	Permits a positive trigger pulse from external equipment to be connected to the signal generator which is in time coincidence with the rf pulse when MODULATION SELECTOR switch is in FM or INT. PULSE positions.

2-2. OPERATING INSTRUCTIONS.

The following instructions are to be followed to ensure proper operation of the Model PMX Microwave Signal Generator.

a. Starting instructions.

1) Measure the line voltage to determine whether it is nominally 115 volts or 230 volts. The 115v-230v input switching system to the unit is normally factory set at 115 volts. If it is desired to use 230 volts as input to the equipment, the internal input switching system must be set at 230 volts. To accomplish this, proceed as follows:

   a) Remove the dust cover as described in paragraph 4-2.
   b) The 115v-230v switch is a six-pole double-throw switch located on the basic unit at the rear of the equipment.
   c) Simply place the switch in the 230v position and replace the dust cover.

2) Connect a 115v or 230v, 50-60 cps, single phase power source to the POWER INPUT 115/230V 50-60 CPS receptacle, on the rear of the dust cover, using the ac line cord supplied.

3) Throw the POWER ON-OFF switch to the ON position. The front panel POWER indicator should light.

4) Allow the signal generator to warm up for at least 15 minutes.

b. Setting Frequency and Power Calibration.

The following procedure shall be used to calibrate the output power of the Model PMX.

1) Rotate the SIGNAL FREQUENCY control until the FREQUENCY IN MEGACYCLES dial indicates the desired operating frequency.

2) Set the MODULATION SELECTOR switch to ZERO SET position. This makes the rf oscillator inoperative.

3) Adjust ZERO SET control until the POWER SET meter pointer is at ZERO.

4) Set the MODULATION SELECTOR switch to CW.

5) Adjust POWER SET control until the POWER SET meter pointer is at POWER SET. The signal generator is now at the one-milliwatt power reference level for the frequency set in step 1.

6) Rotate the R. F. ATTENUATOR control until the ATTENUATION -DBM dial is set to the desired value of rf signal level. The output level is expressed in decibels below one milliwatt, working into a resistive load of 50 ohms.

NOTE

Whenever the setting of the frequency dial is changed, it is necessary to repeat the calibration procedure, as given above, in order to determine the power output.

2-3. Modulation Control Settings

The control settings to obtain the various types of modulation available with the Model PMX are listed in Table 2-2. If the instructions of paragraph b have been followed, the output, with the MODULATION SELECTOR switch in CW position, will be average power and the output, with the MODULATION SELECTOR switch in INT. PULSE and INT. SQ. WV. positions will be peak power.

2-4. Pulse Delay Versus Pulse Repetition Frequency

Figure 2-2 shows the maximum permissible setting of the DELAY controls for pulse repetition rates within the pps range of the equipment. A delay setting greater than depicted by the curve will result in false indications.

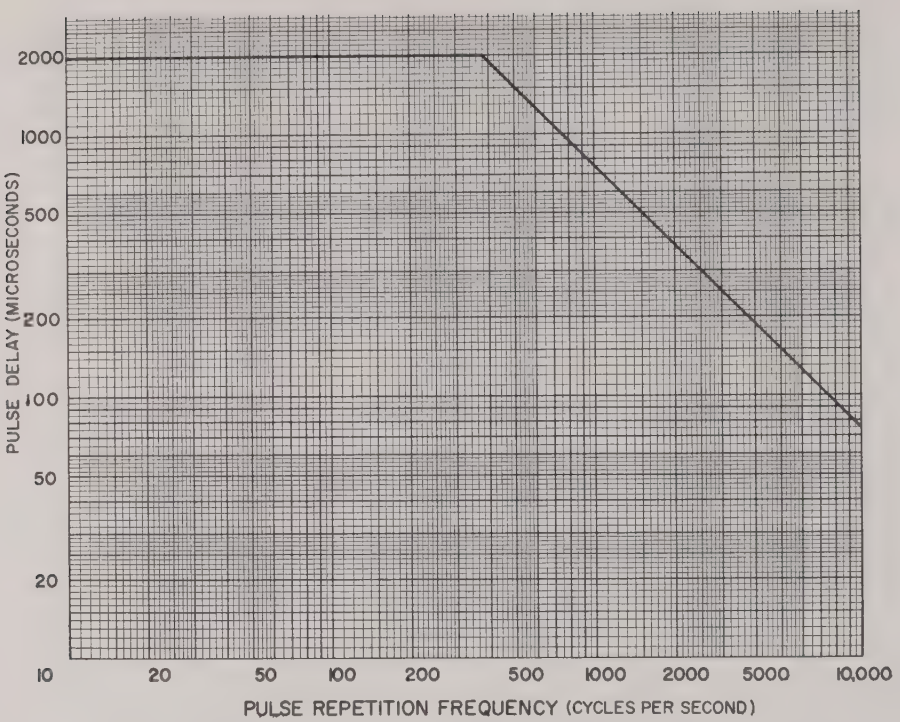


Figure 2-2. Maximum Pulse Delay Vs. Pulse Repetition Frequency

TABLE 2-2. MODULATION CONTROL SETTINGS

Modulation Selector Setting	Sync & Polarity Selector Setting	Repetition Rate Control	Output		Notes
			Rf	Sync Pulse	
CW	None	None	CW	None	
FM	INT. MOD. & SQ. WV.	FREQUENCY CYCLES PER SECOND	FM	Delayed or Undelayed	Use FM AMPLITUDE control as required.
INT. PULSE	INT. MOD. & SQ. WV.	FREQUENCY CYCLES PER SECOND	Pulse Modulated	Delayed or Undelayed	Use PULSE WIDTH and DELAY controls as required.
INT. PULSE	SINE + or -	External source	Pulse Modulated	Delayed or Undelayed	a. Use PULSE WIDTH and DELAY controls as required. b. Connect external source to EXTERNAL SYNC. and MOD. connector.
INT. SQ. WV.	INT. MOD. & SQ. WV.	FREQUENCY CYCLES PER SECOND	Square Wave Modulated	Undelayed	
EXT. MOD.	SINE + or -	External source	Pulse Modulated	None	Connect external source to EXT. SYNC. and MOD. connector.

SECTION 3
PRINCIPLES OF OPERATION

3-1. General

The basic principles of the Polarad Microwave Signal Generator Model PMX, can be understood from the block diagram shown in figure 3-2. The signal generator provides continuous-wave, pulse-modulated, square wave-modulated, and frequency-modulated signals of known intensities and frequency in the range from 4,450 to 11,000 mc in two overlapping bands, through the use of two interchangeable, precision plug-in tuning units.

The Model PMX consists essentially of an rf reflex klystron oscillator operating in an externally tuned cavity, a modulator, a keyer, a power-monitoring bridge circuit, and five self-contained electronically regulated power supplies.

The klystron rf oscillator circuit consists of a reflex klystron tube and its associated external resonant cavity which generates the desired signal. The function of the modulator and keyer circuits is to generate a modulation voltage, either pulse, square wave, or sawtooth in waveform, and to apply this voltage to the reflex klystron oscillator tube. When pulse or square wave amplitude modulation is used, the amplitude modulated signal is applied to the grid of the klystron tube. When frequency modulation is employed, the sawtooth signal from the modulator circuit is applied to the repeller electrode of the klystron. The Model PMX is a free-running pulse generator when the SYNC & POLARITY SELECTOR switch is in the INT. MOD. & SQ. WV. position and the MODULATION SELECTOR switch is in either the INT. PULSE, INT. SQ. WV. or FM positions. Provisions have been made for synchronizing the modulation voltage with an externally applied sine wave, or a pulse signal, either positive or negative, through the EXT. SYNC. and MOD. connector. Provisions have also been incorporated to allow the repeller of the reflex klystron oscillator tube to be modulated with an external pulse signal, either single pulse or multi-pulse, through the EXT. SYNC. and MOD. connector on the front panel.

In addition to producing an rf test signal at the R. F. OUTPUT connector, on the front panel, the signal generator also produces video synchronizing trigger pulses. These positive polarity trigger pulses are available at the DELAYED SYNC. OUT and UNDELAYED SYNC. OUT connectors, also on the front panel.

The SIGNAL FREQUENCY knob controls the movement of both the tracking potentiometer, to vary the klystron repeller voltage, and the non-contacting plunger within the external cavity, to set the desired frequency of the signal generator.

The power monitoring circuit consists of a bridge circuit in which a sliding thermistor probe, positioned by the POWER SET control, is one arm of the bridge. The thermistor probe is located in one of the two waveguide-beyond-cutoff tubes which project from the sides of the klystron cavity. Adjustment of the thermistor probe affects the power absorbed by the thermistor, thereby changing its resistance. Consequently, the bridge is unbalanced and a pointer deflection on the POWER SET meter is indicated. The one-milliwatt power reference level is established, first, by balancing the bridge with no rf power applied, and second, by adjusting the thermistor probe until the pointer on the POWER SET meter deflects to the POWER SET position. A sliding pick-up loop in the other waveguide-beyond-cutoff tube is employed to set the rf power output. This adjustment is controlled by the front panel R. F. ATTENUATOR when the power reference level has been set, and the ATTENUATION -DBM dial reads "0", at which time one milliwatt of rf power is available at the R. F. OUTPUT connector. When the MODULATION SELECTOR switch is in ZERO SET position, there is no rf output available at the R. F. OUTPUT connector.

Five separate power supplies are incorporated in the Model PMX. Figure 3-1 illustrates, in simplified block diagram form, the supplies, their outputs, and their relation to each other. The BEAM SUPPLY (paragraph 3-2) provides the necessary anode to cathode voltage for the klystron tube. The REPELLER SUPPLY (paragraph 3-3) provides the voltages required to enable the tracking potentiometer to vary the klystron cathode to repeller voltage. The KEYER SUPPLY (paragraph 3-4) provides the necessary voltages for the keyer circuit and also sets the grid bias for the klystron tube. The +210v SUPPLY (paragraph 3-6) provides the B+ voltage for the internal modulator and the MODULATOR SUPPLY (paragraph 3-5) the necessary voltage for the power monitor bridge plus the modulator bias voltage.

3-2. Beam Power Supply (See figure 5-7.)

The main function of the beam power supply is to supply the required voltages and currents to the interaction grids of the reflex klystron oscillator tube V102, so that the interaction grids are maintained at a positive potential with respect to the klystron cathode. Since these grids contact the klystron oscillator barrel assembly, it is safer to ground the positive side of the power supply. The beam power supply consists of two voltage doubler rectifiers V1 and V2, a series regulator V3, a dc amplifier V4, and two voltage regulator tubes V5 and V6. The screen voltage for V3 is provided by the +210-volt supply. Control grid voltage for the dc amplifier is obtained through the -1250V ADJ. potentiometer R8, a part of the

power supply bleeder. The potentiometer is a screwdriver adjustment which sets the voltage output of the power supply to the required level.

3-3. Repeller Power Supply (See figure 5-7.)

The function of the repeller supply is to furnish a repeller voltage which is always negative with respect to the cathode of the klystron tube. In order to make this repeller voltage negative, the positive side of the repeller power supply is connected to the negative output of the beam power supply. Therefore, though the total output variation from the circuit is 600 volts, the absolute potential varies from -1250 volts to -1850 volts. The -1850V ADJ. potentiometer R31, is a screwdriver adjustment used to set the proper voltage for the repeller tracking circuit. A fixed -1400 volts is available at the plate of voltage regulator V12, and is used as a common reference voltage for the cathodes of the keyer power supply and keyer circuit. The -1550 volts available at the cathode of V12 is used as a negative bias and reference voltage for the keyer power supply and keyer circuit, with respect to the -1400 volt line. The repeller power supply consists of rectifier V7, series regulator V8, dc amplifier V9, and voltage regulator tubes V10, V11, and V12.

3-4. Keyer Power Supply (See figure 5-7.)

The keyer power supply furnishes the B+ voltage for the plates and screen grids of the keyer circuit, and sets the klystron grid bias when the signal generator is set for cw operation. The keyer supply output ranges from 150 to 170 volts. The proper voltage setting is dependent upon the klystron bias needed to allow 18 to 25 milliamperes of beam current to flow in the klystron oscillator. BEAM CURRENT ADJ. potentiometer R127 is used to set the klystron grid bias when the signal generator is set for cw operation. The keyer power supply consists of V103, a full-wave rectifier, a series regulator V104 and V105, a combination dc amplifier and voltage control tube. The negative side of this supply is referenced to the -1400 volt line and is taken from a fixed reference point in the repeller power supply.

3-5. Modulator Power Supply

The modulator power supply provides a constant -108 volts which is used to balance the power bridge circuit. In addition, the modulator supply furnished the required bias voltage for the internal modulator. The

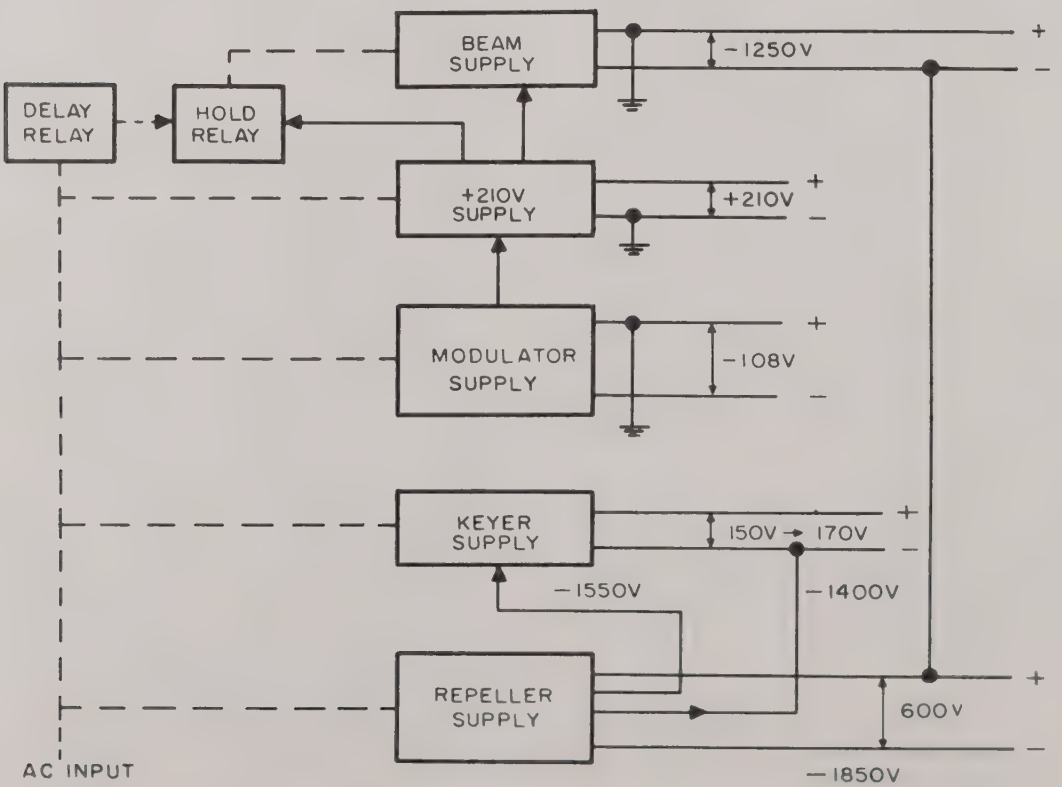


Figure 3-1. Power Supplies, Block Diagram

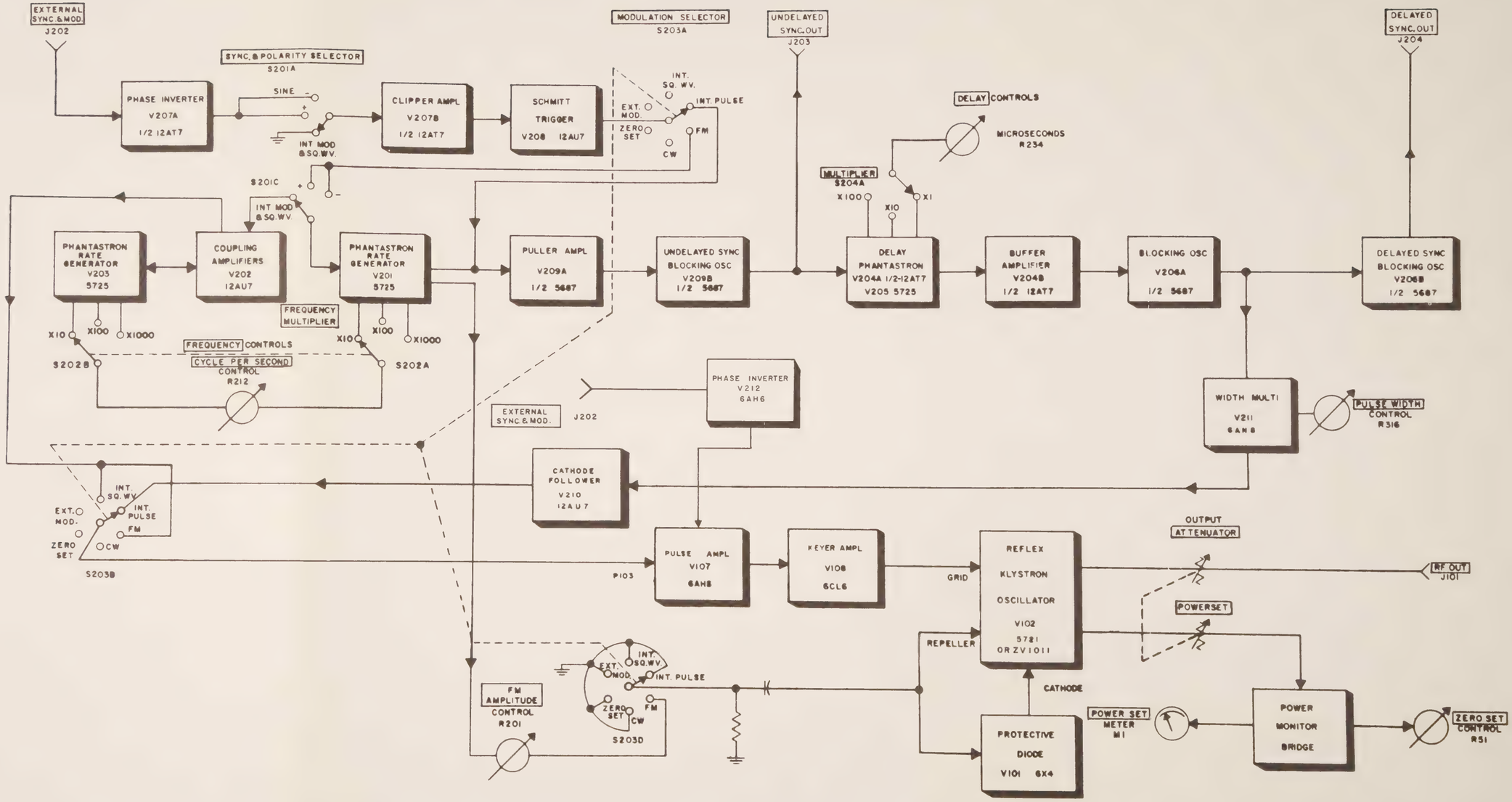


Figure 3-2. Signal Generator, Model PMX, Block Diagram

modulator power supply consists of a full-wave rectifier V13, a series regulator V14, a dc amplifier and voltage control tube V15, and a voltage regulator tube V16.

3-6. +210V Power Supply (see figure 5-7.)

The +210 volt power supply is a functional part of the modulator power supply and serves to provide B+ voltage for the modulator circuit. The +210 volt supply furnishes the power required to energize HOLD RELAY K2 through DELAY RELAY K1, when the normally open contacts (3 and 8) close. Rectification is accomplished by V17, while V18 serves as a series regulator stage. V19 is a dc amplifier and voltage control tube with V20 as the voltage regulator for the power supply. +210V ADJ potentiometer R63 permits the output voltage of the power supply to be set to the required level.

3-7. Klystron Oscillator Circuit

The oscillator circuit uses a reflex klystron tube, operating in an externally tuned cavity, which generates cw signals (figure 3-3). The klystron cavity is in the form of a coaxial transmission line consisting of two cylinders, one inside the other. The klystron tube is inserted at one end of this transmission line so that the outer cylinder makes contact with the first interaction grid (so termed because it is closer to the cathode), while the inner cylinder makes contact with the second interaction grid. At the other end, the resonator "short" circuit is completed by a movable non-contacting plunger of special electrical design. The SIGNAL FREQUENCY knob, located on the front panel, controls the movement of the plunger within the cavity to set the resonant frequency. Simultaneously, this control adjusts the tracking potentiometer which applies the proper voltage to the klystron repeller to insure operation within its repeller mode. The waveguide-beyond-cutoff tubes, projecting from the cavity, couple rf energy to the attenuator and the power monitor. Protective diode V101 is connected between the repeller and cathode of the klystron tube to keep the repeller from going positive with respect to the cathode. The required conditions for oscillation at resonant frequencies are obtained when the klystron oscillator is operated in the 4-3/4 and 2-3/4 cycle repeller mode and the 3/4 wavelength cavity mode for the G48 tuning head. The G711 tuning head uses a 4-3/4 and 3-3/4 cycle repeller mode and a 3/4 wavelength cavity mode. Figure 3-4 is a graph showing oscillating frequencies plotted against a range of repeller voltages. This cavity frequency curve represents the repeller mode as it is determined by the tracking of the plunger (choke) and potentiometer R101,

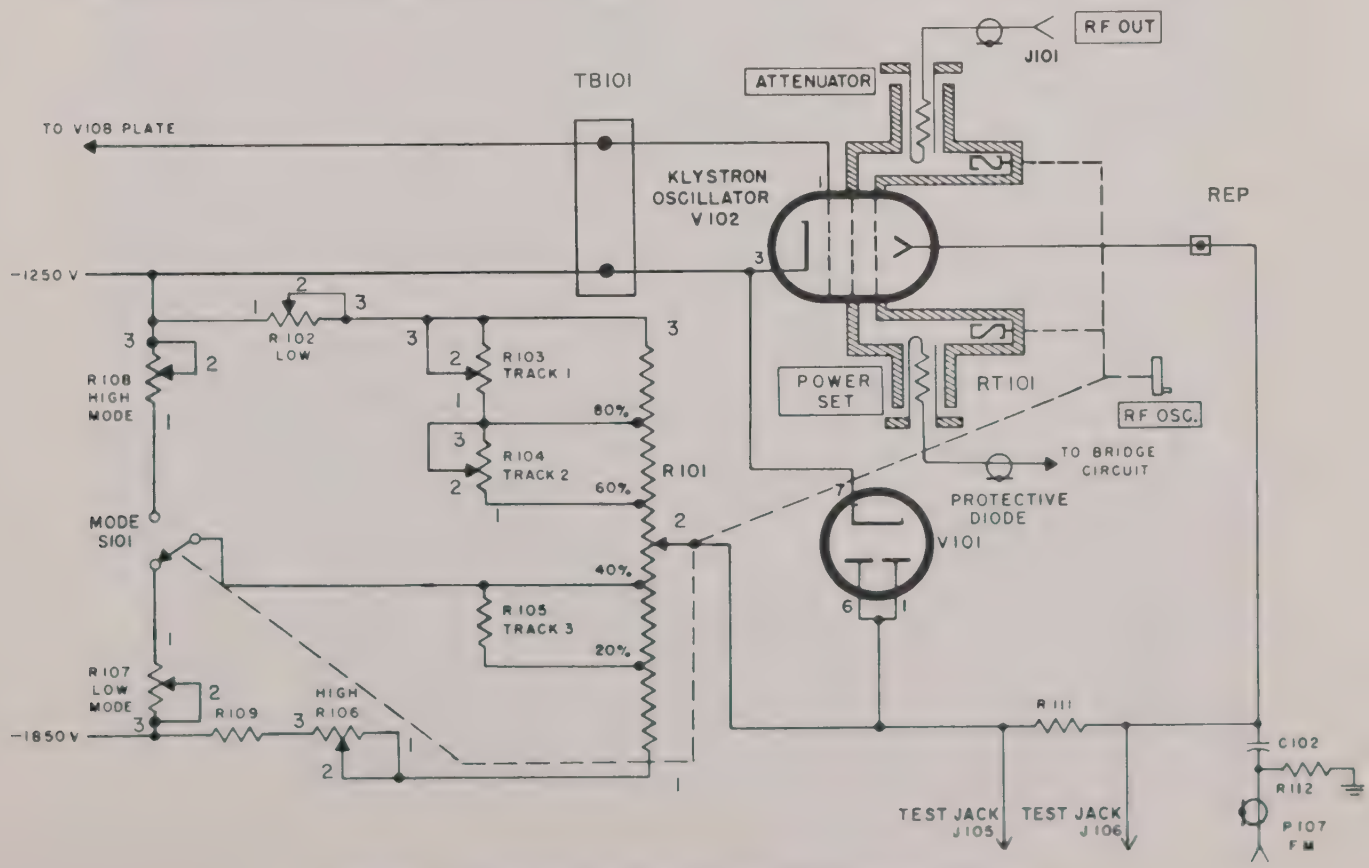


Figure 3-3. Klystron Oscillator, Simplified Schematic Diagram

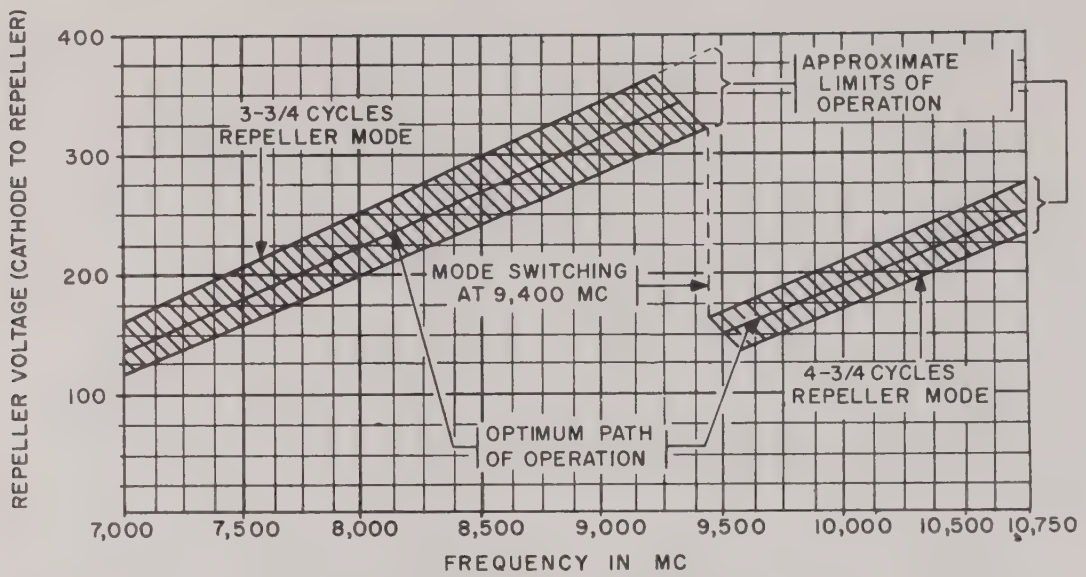


Figure 3-4A. 3-3/4 and 4-3/4 Repeller Modes (Tuning Unit G711, 6,950 to 11,000 MC)

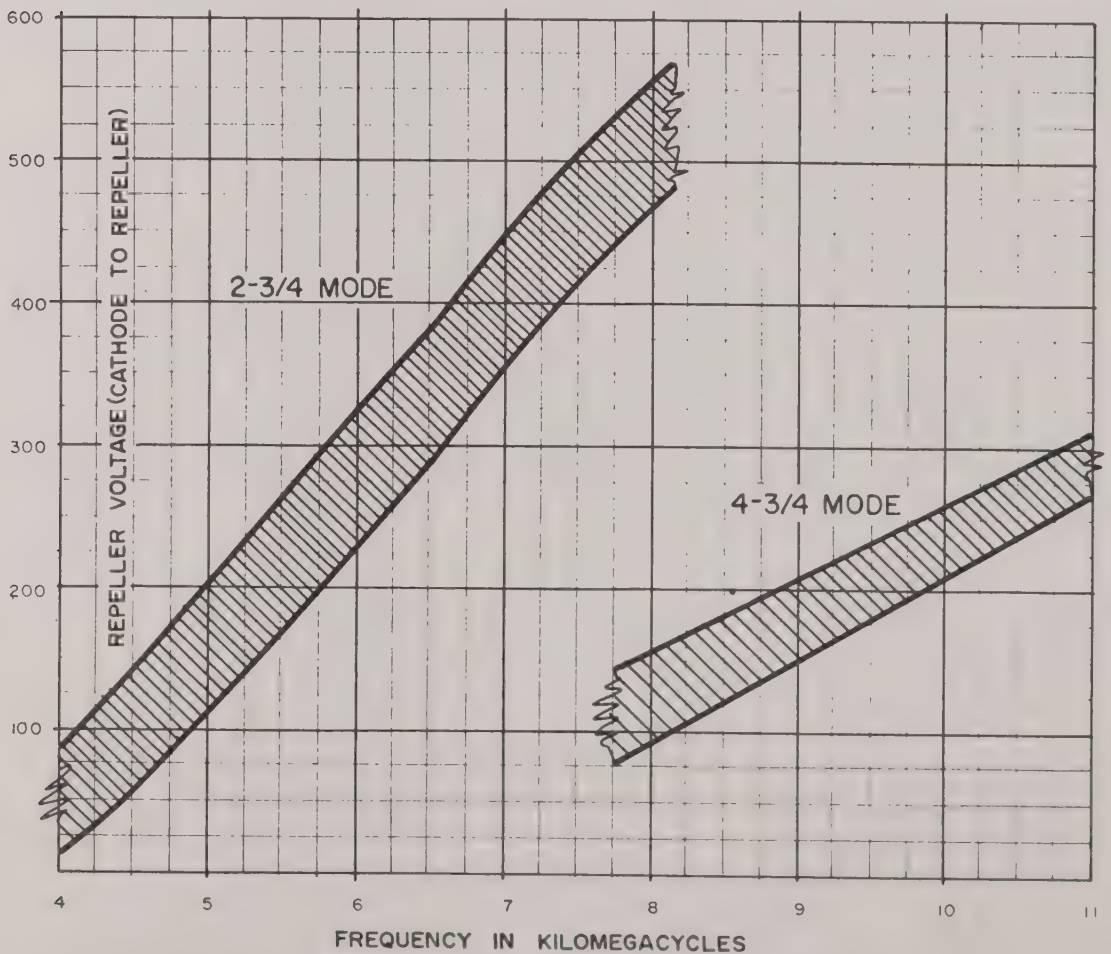


Figure 3-4B. 2-3/4 and 4-3/4 Repeller Modes (Tuning Unit G48, 4,450 to 8,000 MC)

and gives the settings of potentiometers R103 through R105 (TRACK 1 through TRACK 3). Potentiometers R102 and R106 set the low and high voltage limits, respectively. The LOW MODE potentiometer R107 and the HIGH MODE potentiometer R108 are screwdriver adjustment controls, which permit the initial setting of the repeller voltage. A cam controlled by the rotation of the SIGNAL FREQUENCY knob automatically actuates MODE switch S101, thereby switching the repeller voltage from the 4-3/4 to the 2-3/4 mode for the G48 tuning head and from the 4-3/4 to the 3-3/4 for the G711 tuning head.

3-8. Power Monitoring Circuit

The rf power monitor circuit is used to calibrate the output of the attenuator. The power monitoring circuit consists of a Wheatstone bridge of which one arm is a variable resistance element (thermistor) which measures the power. A thermistor has a negative temperature coefficient of resistance, for example, as the temperature increases, the resistance decreases, and as temperature decreases, resistance increases. Changes of thermistor temperature, and hence resistance, are governed by three factors. These are: thermal changes in its environment; the current flowing through it; and absorbed rf power. By controlling the current required for balance, the bridge will determine the rf power by measuring the change in thermistor resistance caused by the applied rf power. Two types of thermistors are used in the power monitoring circuit, the bead (RT101) and the disc (RT102 and RT103). The bead thermistor, used for power measurement, has a small mass and is affected by all of the changes mentioned above. The disc thermistor, used in compensating networks, has a large mass and its resistance is relatively insensitive to the current flowing through it. The disc thermistor is dependent, primarily, on the ambient temperature.

The basic bridge circuit is balanced (ZERO on POWER SET meter) by adjusting the ZERO SET potentiometer R51 and the COARSE ADJ potentiometer R50. The COARSE ADJ potentiometer is factory adjusted to permit the ZERO SET control to cover the entire temperature operating range. Normally, this potentiometer need not be adjusted. Adjustment is required if the POWER SET meter goes beyond full scale deflection. See table 5-1 for the procedure required for proper adjustment of COARSE ADJ R50. The power monitoring bridge is so designed that for a given frequency the bead thermistor must be inserted into the cutoff waveguide so that one milliwatt of rf power will be indicated by the POWER SET mark on the meter. Movement of the bead thermistor is controlled by the POWER SET control on the front panel.

3-9. Attenuator

The attenuator couples the resonant frequency output of the klystron oscillator to the R. F. OUTPUT receptacle on the front panel. A piston attenuator assembly is inserted into the waveguide-beyond-cutoff tube. This assembly is controlled by the front panel R. F. ATTENUATOR control through a rack and pinion gear. The ATTENUATION -DBM dial affords direct reading of the output in decibels below a one milliwatt reference level with a 50-ohm resistive load. The setting of the one milliwatt reference level is a function of the power monitoring circuit discussed in the preceding paragraph.

3-10. Modulated Operation

When the Model PMX is switched into modulated operation, the klystron keying voltage may be supplied by an external pulse or by the modulator section. The klystron keying voltage, supplied by the modulator, may be triggered by an external pulse or an internal pulse or sawtooth. Delayed and undelayed sync pulses are available when the modulator section supplies the keying voltage.

3-11. Internal Modulation

When SYNC & POLARITY SELECTOR switch S201 is in INT. MOD. & SQ. WV. position and MODULATION SELECTOR switch S203 is in INT. PULSE position, the signal generator functions as a self-triggered, self-synchronous pulse generator. The keying voltage is then supplied by the keyer circuit, which is triggered by the modulator section.

3-12. Rate Generator Circuit V201, V202, and V203

Two identical free-running, screen-coupled phantastron circuits, connected back-to-back with coupling amplifiers, supply the necessary triggers for internal pulse and square wave modulation, plug the sawtooth voltage for frequency modulation, at a controlled repetition rate. The repetition rate is determined by the value of capacitance switched into the plate-to-control grid circuit of the respective phantastrons by means of sections A and B of FREQUENCY MULTIPLIER S202, and by the value of resistance set by FREQUENCY CYCLES PER SECOND control R212, in conjunction with LOW FREQ. ADJ. R217 and SQ. WV. SYMMETRY ADJ. R211, in the control grid circuit of tubes V201 and V203. Table 3-1 is a convenient tabulation of various repetition frequency ranges.

TABLE 3-1. SETTINGS FOR REPETITION FREQUENCY RANGES

Frequency Cycles Per Second Control	Frequency Multiplier Control	Repetition Frequency Range
1 - 10	X10	10 - 100
1 - 10	X100	100 - 1,000
1 - 10	X1,000	1,000 - 10,000

The LOW FREQ. ADJ. R217 is an internal adjustment which is used to set the low pulse frequency limit. SQ. WV. SYMMETRY ADJ. R211 is an internal adjustment which is used to make the square wave symmetrical. In pulse operation, the screen waveform of phantastron V201 is differentiated by an RC network consisting of C204 and the parallel combination of R204 and R281. The resultant pulse is then fed to puller amplifier V209A.

In SQ. WV. operation, phantastron V201 performs in the manner described above, and the suppressor waveform from phantastron V203 is differentiated by the RC network consisting of C210 and the parallel combination of R300 and R306. The resultant pulse of this circuit is then coupled, through MODULATION SELECTOR S203B, to puller amplifier V210A. Each phantastron rate generator is operative for 50% of the total period.

In FM operation, the sawtooth output from the plate of phantastron rate generator V201 is controlled by the front panel FM AMPLITUDE control R201. This controlled sawtooth voltage is applied directly to the klystron repeller.

3-13. Undelayed Sync Blocking Oscillator V209

Puller amplifier V209A receives the differentiated screen waveform from phantastron rate generator V201 and couples the signal to blocking oscillator V209B. Undelayed sync blocking oscillator V209B is a triggered blocking oscillator for the purpose of providing sharp pulses in either INT. PULSE or SQ. WV. position of MODULATION SELECTOR S203. Triggers of 0.25 microsecond in width, and better than 0.1 microsecond in rise time, with a minimum amplitude of 15 volts positive, are available at the UNDELAYED SYNC. OUT receptacle on the front panel. The undelayed sync pulse leads the leading edge of the modulated test signal by an amount indicated by the delay controls. In pulse modulation, triggers from the cathode of V209B are fed to the suppressor grid of delay phantastron V205 through diode CR211, where the negative peaks are clipped. In SQ. WV. operation, the negative pulses at the plate of V209B are fed to multivibrator V106, in the keyer circuit, through S203C (part of the MODULATION switch) and SET J104.

3-14. Delay Phantastron V205

The trigger at the cathode of V209B is coupled to the suppressor grid of delay phantastron V205, which is a screen-coupled phantastron circuit with a speedup cathode follower (V204A). The positive trigger applied to the suppressor grid allows the plate of the phantastron tube to draw current. When this happens, the plate voltage drops, the grid voltage drops proportionally, the cathode current falls, and the screen voltage rises. This action causes the suppressor voltage to rise because it is obtained from the same bleeder as the screen potential. The plate voltage then runs down linearly as in the Miller circuit. The end of this period comes when the control grid goes positive again, resulting in an increase of cathode current, in suppressor cutoff, and heavy screen current. The delay is adjusted by varying the RC time constant of R224 and the capacitors of DELAY MULTIPLIER S204A. The delay is also adjusted by varying the plate clamping potential of V205. DELAY MULTIPLIER selector S204A switches different value capacitors into the plate-to-grid circuit, which change the delay range. MIN DELAY ADJ R233 is used to set the minimum delay of the phantastron circuit. DELAY MICROSECONDS potentiometer R234 is the fine delay control on the front panel of the equipment.

The delayed pulse from the suppressor grid of phantastron V205 is fed to voltage divider R229 and R230, which provide bias for buffer amplifier V204B, and is applied to the grid of the buffer amplifier. Buffer amplifier V204B serves to isolate, amplify, invert, and differentiate the output signal. The positive pulse from this amplifier is coupled to blocking oscillator V206A, which drives the width multivibrator V211.

3-15. Delayed Sync Blocking Oscillator V206B

Delayed sync blocking oscillator V206B is a triggered blocking oscillator circuit supplying a sharp positive pulse output from the cathode and a negative pulse output from the plate. Both outputs have a repetition rate identical to the output of delay phantastron V205. The delay time of these outputs is determined by the delay phantastron output pulse. The positive pulse output from the cathode of V206B is fed to front panel DELAYED SYNC OUT receptacle J204. This positive pulse is in time coincidence with the leading edge of the modulated pulse output.

3-16. Width Multivibrator V211

The width circuit of the modulator section consists of a monostable multivibrator using a triode-pentode circuit configuration. The repetition is controlled by the repetition rate of the positive driving pulse from the cathode of blocking oscillator V206A. The effective width of the multivibrator output is adjustable between 0.2 and 10 microseconds by the fine PULSE WIDTH MICROSECONDS control R316 on the front panel. MIN WIDTH ADJ R315 sets the minimum pulse width.

3-17. Cathode Follower V210

The pulsed output of multivibrator V211 is fed to cathode follower V210 which acts in the conventional manner as an impedance-lowering device. Its high input impedance and very low output impedance make it particularly suitable for coupling between the pulse-generating and pulse-amplifying circuits where shunt capacitance could otherwise cause objectionable effects. V210 is a dual-triode with both halves connected in parallel for maximum power-handling capacity. Power amplification is obtained because the ratio of input impedance to output impedance is very large. The low-impedance output is fed to the INT. PULSE position of modulation selector switch S302B.

3-18. Pulse Amp. V107 & Keyer Amp. V108

Pulse amplifier V107 amplifies the output of cathode follower V210 during INT. PULSE operation, and amplifies the output of coupling amplifiers V202 during INT. SQ. WV. and FM operation. During external modulation it amplifies pulses from an external source. The external signals are applied to V107 via EXT. MOD. receptacle J202, phase inverter V212, SYNC & POLARITY SELECTOR S201D, and relays K101 and K102. In INT. PULSE. INT. SQ. WV. and FM operation, the pulse taken off the plate of V107 is coupled by C115 through K102 to the control grid of keyer amplifier V108. V108 is thus driven to cut-off. During this cut-off period. klystron V102 oscillates. The klystron cathode-to-grid voltage is determined by the setting of BEAM CURRENT ADJ R127 in the keyer supply, (which is referenced to -1400 volts), while V108 is cut off. In CW operation the control grid of V108 is brought to a voltage divider consisting of R147 and R143. Negative 50 volts (with reference to the -1400 volt line) is supplied, which cuts off the keyer amplifier tube and allows the klystron to oscillate. The peak power output in pulse operation is the same as that for CW operation.

3-19. External Sync Circuit

Provision is made for synchronizing the modulation voltage with an internally applied sine wave or a positive or negative pulse signal through EXTERNAL SYNC. and MOD. receptacle J202 on the front panel. After amplification and inversion by phase inverter V207A, the resultant pulse is fed to the control grid of clipper amplifier V207B which then couples the signal to the Schmitt trigger V208 and its associated circuitry. The Schmitt trigger circuit has a constant peak value output (a flat-topped pulse) which is independent of the shape of the input voltage waveform. The duration of the positive portion of the square wave output corresponds to the period that the input waveform exceeds a specific voltage.

3-20. External Sync Modulation

Operation of the signal generator with external sync modulation is identical to internal modulation operation, except that SYNC & POLARITY SELECTOR S201 is set to correspond to the polarity of the applied external signal. The external pulse applied at the front panel EXTERNAL SYNC. and MOD. receptacle J202, is used to trigger phantastron rate generator V201 when S203A (part of the MODULATION SELECTOR switch) is in either FM or INT. PULSE position.

3-21. FM Modulation

When MODULATION SELECTOR switch S203 is in FM position. a sawtooth voltage from the plate of phantastron rate generator V201 is fed through FM connectors J107 and P107 to C102. This capacitor couples the voltage directly to the repeller electrode of the klystron oscillator tube. The output of the klystron is then frequency-modulated at a deviation rate dependent upon the setting of the front panel FM AMPLITUDE control R201. In any other position of the S203 switch the modulating sawtooth voltage is cutoff.

3-22. Protective Relays

When POWER ON-OFF switch S1 is closed, 115 volts ac is applied to all circuits except the Beam Power Supply. In order to protect the klystron oscillator tube, thermal time DELAY RELAY K1 is energized through the normally closed contacts (7 and 2) of HOLD RELAY K2. After a time delay of 60 seconds, contacts 3 and 8 of DELAY RELAY K1 close. A dc voltage from the +210-volt supply passes through the coil of HOLD RELAY K2, the normally open circuit contacts, 3 and 4. close and apply ac to the beam supply simultaneously deenergizing DELAY RELAY K1.

3-23. Functional Operation of the Mechanical Components

Figure 3-5, the electro-mechanical schematic diagram, illustrates the mechanical operation of the Model PMX tuning assembly. The tuning plunger does not mechanically contact the inner and outer conductors. Broadband effective "short-circuit" is achieved by making the choke approximately a 1/4 wavelength at mid-band, keeping the gap between the choke and inner and outer conductors to a practical minimum and using teflon as a bearing surface.

There are two required conditions for proper oscillation. The plunger must be at a predetermined position within the coaxial line and the repeller voltage must be at some proper value within a predetermined repeller mode. The plunger is driven by a cam which corrects for the non-linearity of plunger position with frequency. With a fixed cam, the variation of tuning curve from klystron to klystron would not permit better than an approximately five per cent frequency dial accuracy. Frequency dial accuracy, with tube changes, is improved to one per cent by making the cam adjustable through five variable eccentric points. The second requirement for oscillation is obtained by mechanically ganging a tapped potentiometer to the cam shaft that automatically tracks and switches repeller modes. The cavity has two identical waveguide-beyond-cutoff outputs; the guide for the thermistor probe, which is one arm of a Wheatstone bridge and that for the output attenuator. Adjustment of the POWER SET control moves the thermistor probe. The R. F. ATTENUATOR control varies the attenuator probe independently of the thermistor probe.

To calibrate the output attenuator, the Wheatstone bridge is balanced with the rf oscillator off. With the oscillator on, the POWER SET control is adjusted so that the POWER SET meter reads mid-scale. Actual power output can now be read directly from the ATTENUATION -DBM dial. If the rf oscillator is changed to any other frequency, the same calibrated rf output is maintained simply by readjusting the POWER SET control so that the meter reads mid-scale. Manual adjustment of frequency is made with the SIGNAL FREQUENCY control.

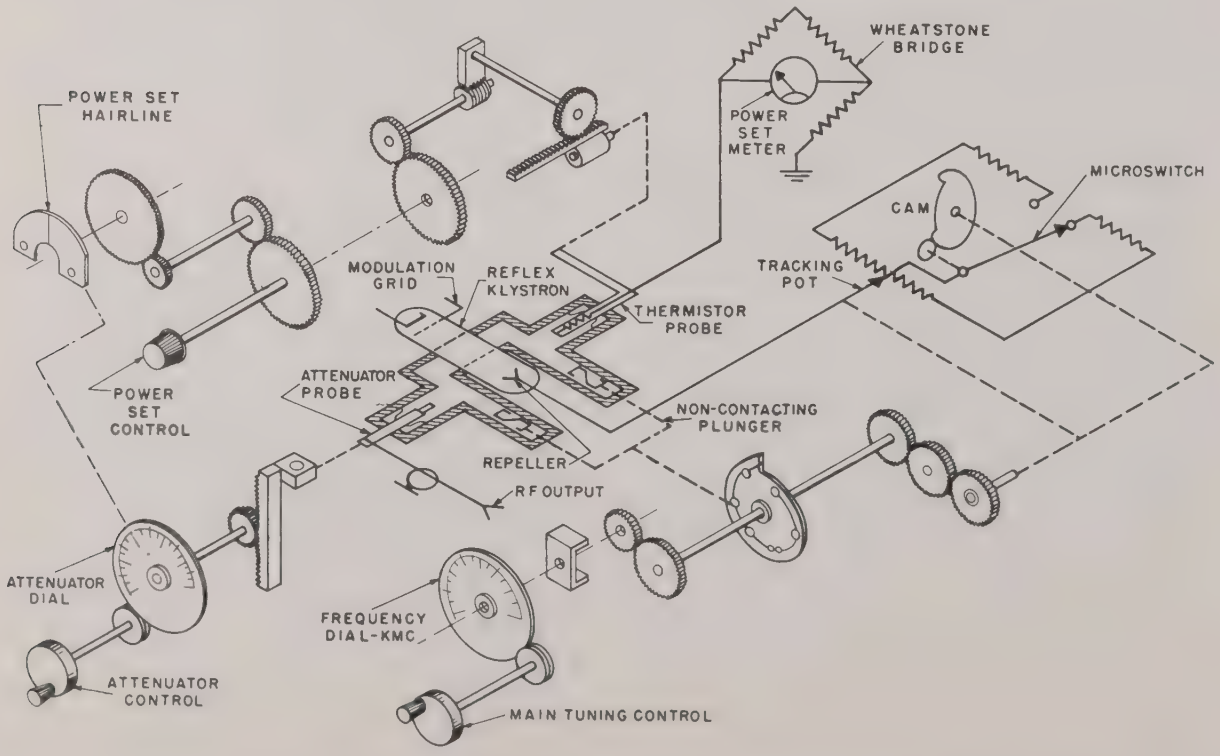


Figure 3-5. Signal Generator Model PMX, Electro-Mechanical Schematic Diagram

SECTION 4
MAINTENANCE

4-1. General

An understanding of the circuit theory of operation, as described in Section 3, will proved helpful in locating and correcting any defect which may occur. The mechanical drive systems are designed for life-of-equipment operation, and should not be tampered with unless a breakdown occurs. Unnecessary adjustments of the klystron oscillator and calibrated modulator circuit should not be made, since these changes may result in loss of accuracy.

4-2. Access to the Equipment

To remove the signal generator from its case, set the unit face down. Loosen the camlocks located at each corner of the rear of the dust cover. Slide the case upward.

To gain access to components located on the sub-chassis, proceed as follows:

CAUTION

When sliding the unit or sub-assemblies out of the frame, ensure that the tuning unit is set to its highest frequency and that cables are clear of components and chassis.

a. Remove the six machine screws, which secure the modulator front panel to the main frame. Remove connectors P2, P103, and P107 from their sockets to completely disengage the subchassis. Pull the modulator subchassis completely out of the main frame for inspection and testing.

b. Remove the four machine screws, located on the front panel of the rf and keyer chassis. These screws secure the rf and keyer chassis to the main frame. Remove connectors P1, P2, P103, and P107 from their sockets, to completely disengage the rf and keyer chassis. Withdraw the chassis from the main frame for inspection and testing. Put both the main frame and the rf and keyer chassis back-to-back, and reconnect plugs.

4-3. Preliminary Inspection Procedures

Preliminary inspection comprises a series of operations performed on the signal generator, with the equipment de-energized, to correct conditions which might lead to a breakdown. These breakdowns may be caused by an accumulation of dust and dirt on components and parts or by loose connections and fittings. Table 4-1 lists the preliminary inspection procedure to be performed on the Model PMX, Microwave Signal Generator.

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE.

USE EXTREME CAUTION IN MAKING ALL VOLTAGE CHECKS. REMOVE POWER AND DISCHARGE ALL CAPACITORS BEFORE TOUCHING THEM. DO NOT TOUCH VACUUM TUBES UNTIL THEY HAVE COOLED, OR SEVERE BURNS MAY RESULT.

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE

Step	What to Inspect	Defects	Remedies	Precautions
1	Ac line cord, video cable, and rf cable.	Kinks in the cable, cuts, deteriorations, and fraying of the rubber insulation.	Replace the cable, if necessary.	Make sure that proper type and length of cabling is used.
		Loose connectors.	Tighten or resolder connections, or replace cable.	
		Dirt, oil, grease, corrosion.	Clean with lint-free cloth moistened with carbon tetrachloride; then wipe dry.	CAUTION: Repeated contact of carbon tetrachloride with skin or prolonged breathing of fumes, is dangerous. Make sure adequate ventilation is provided.
2	Power set meter.	Bent indicator, cracked or broken glass.	Replace the meter, if necessary.	
3	Knobs, screws, connectors, and handles.	Looseness.	Tighten.	Tighten carefully, so as not to damage screws on equipment.
4	Switches.	Inability to change positions or evidence of slipping.	Replace all defective switches.	

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE (Continued)

Step	What to Inspect	Defects	Remedies	Precautions
5	Rear of panel and chassis.	Dirt, corrosion, moisture, and rust.	Remove loose dirt and dust with a brush or low air pressure. Remove dirt and grease on the chassis or panel with a brush or cloth dipped in carbon tetrachloride.	
6	Mounting screws and clamps.	Looseness.	Tighten.	Do not tighten slotted shafts of variable resistors.
7	Solder joints.	Loose or cold soldered joints and corroded joints.	Resolder, clean and resolder.	
8	Capacitors.	Leaks, bulges, and signs of discoloration.	Replace capacitor.	
9	Pilot lights.	Jewel cracked, broken or missing, light does not operate.	See that all lamps are operating. Replace burned out lamps. Replace missing, broken or cracked jewel.	
10	Tubes, except for reflex klystron.	Poor seating.	Press tubes firmly into sockets.	Never work on tubes immediately after shutdown, severe burns may result. Do not jiggle tubes or partially withdraw them from sockets. Such movements tend to weaken tube pins and spread the contacts in the socket. Do not check the reflex klystron tube.
11	Tube shields, except for reflex klystron.	Looseness. Missing shields.	Press tube shields firmly into position. Replace missing shields.	
12	Tube sockets.	Looseness. Cracks, chips.	Tighten mounting screws. Replace socket, if necessary.	
13	Oscillator drive.	Catching or jamming when SIGNAL FREQUENCY knob is rotated. Dust, dirt or foreign matter in oscillator gear box or on oscillator drive shaft. Bent or broken teeth on gears.	Clean. Remove all foreign matter. Return to manufacturer or obtain replacement.	CAUTION: Do not drive oscillator in any way other than by its control knob. Do not interfere in any way with the operation of the gear mechanism while the control is being turned. Never use force.
14	Thermistor and attenuator drive assembly.	Catching or jamming	Remove dirt and foreign matter with a brush or lint free cloth dipped in carbon tetrachloride.	CAUTION: Refer to caution for Oscillator Drive (step 13) and AC line cord (step 1).

4-4. Trouble Shooting

Table 4-2 lists the trouble shooting procedure for localizing a defect to a particular circuit. Figures 4-1 and 4-2 show the right and left views of the complete unit. Figure 4-3 is a top view of the Low Voltage Power Supply showing the location of components, and figure 4-4 is a view showing the components located on the underside of the chassis. Figure 4-5 is a component layout of the modulator section of the equipment which will aid in locating components. Figures 4-6 and 4-7 are photographs of the top and bottom of the Repeller and Beam Chassis, respectively, showing the location of components.

NOTE

Do not disturb any preset adjustments unless the trouble is definitely caused by a chassis adjustment control.

As the first step in any trouble shooting, check the power supplies, and relays K101 and K102, for proper operation. It is advisable to follow Table 4-2, the trouble shooting chart, step by step during trouble shooting of the unit.

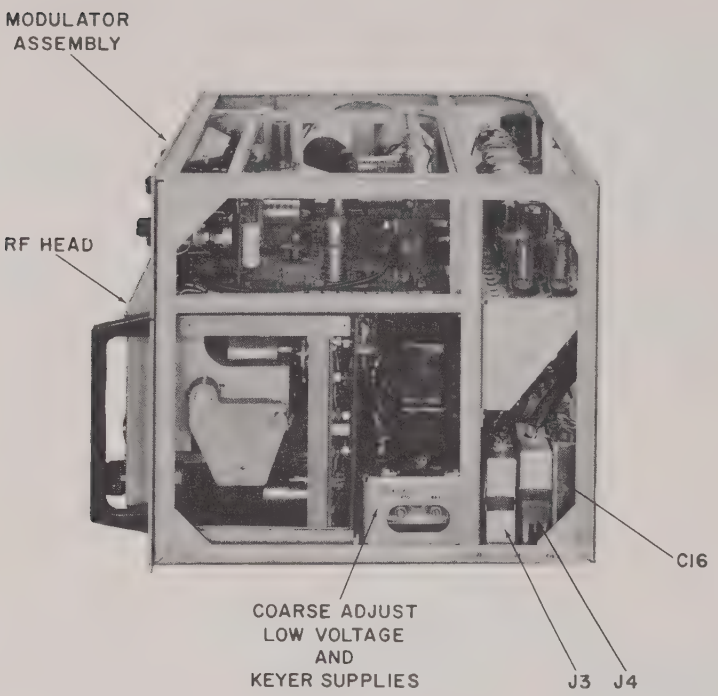


Figure 4-1. Microwave Signal Generator Model PMX, Side View Right

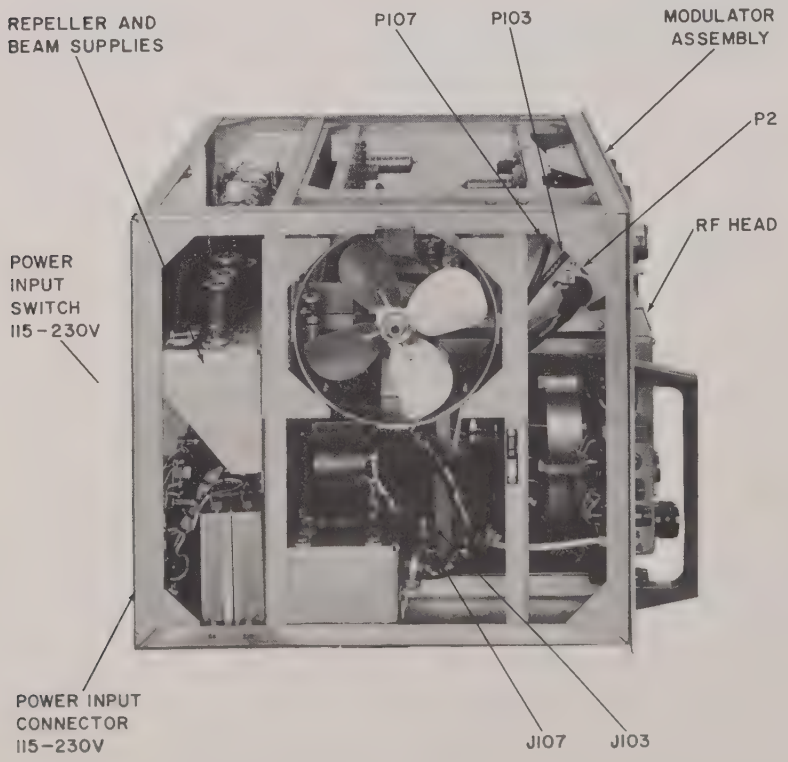


Figure 4-2. Microwave Signal Generator Model PMX, Side View Left

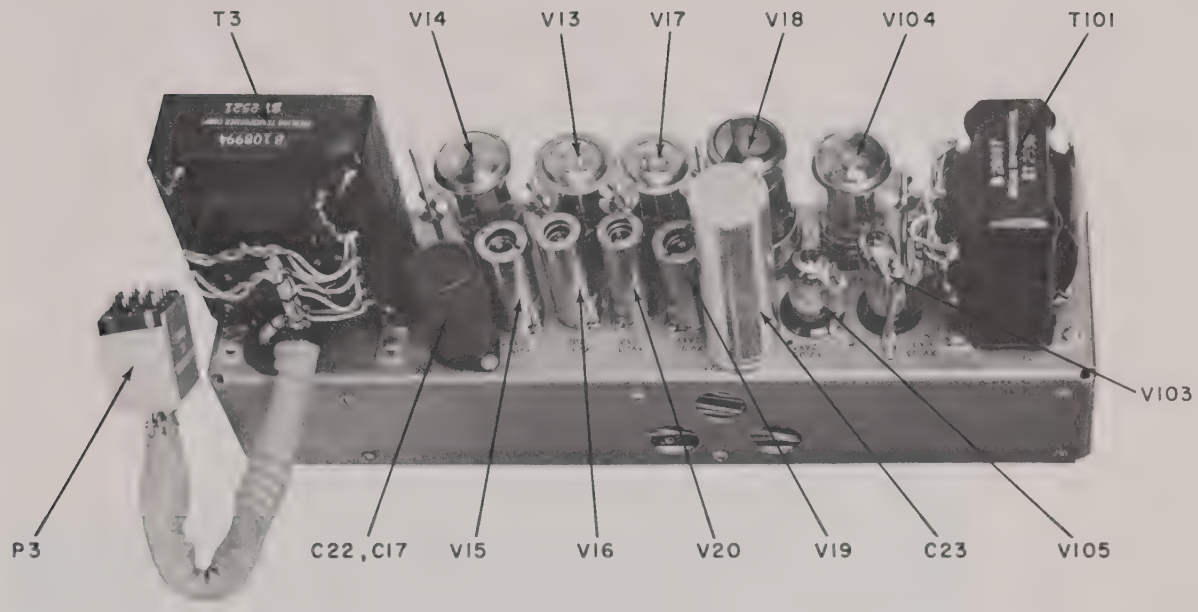


Figure 4-3. Low Voltage and Keyer Power Supply, Top View

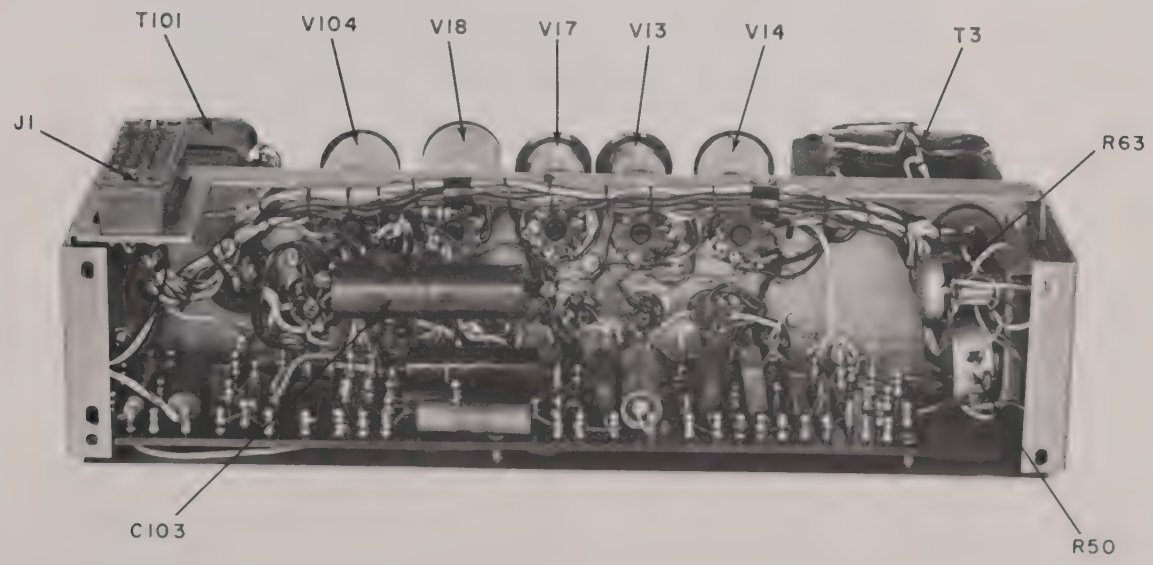


Figure 4-4. Low Voltage and Keyer Power Supply, Bottom View

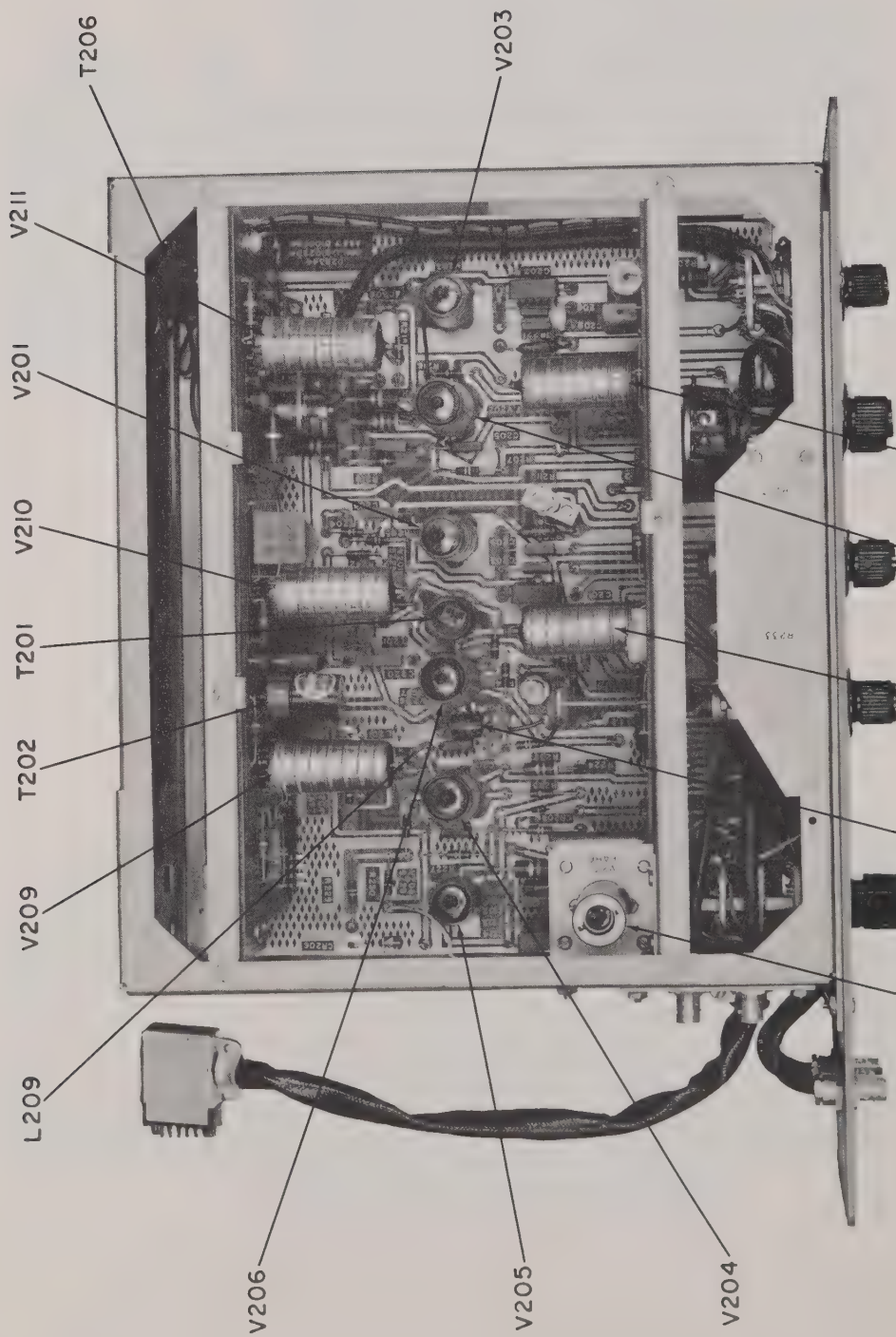


Figure 4-5. Modulator Assembly, Component Layout

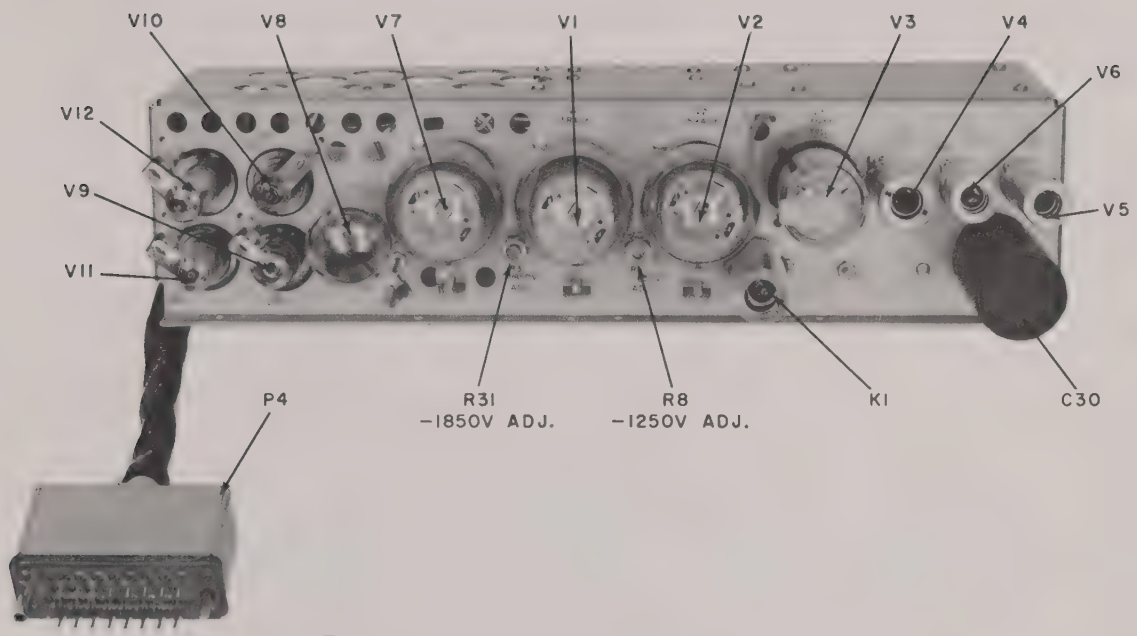


Figure 4-6. Repeller and Beam Chassis, Top View

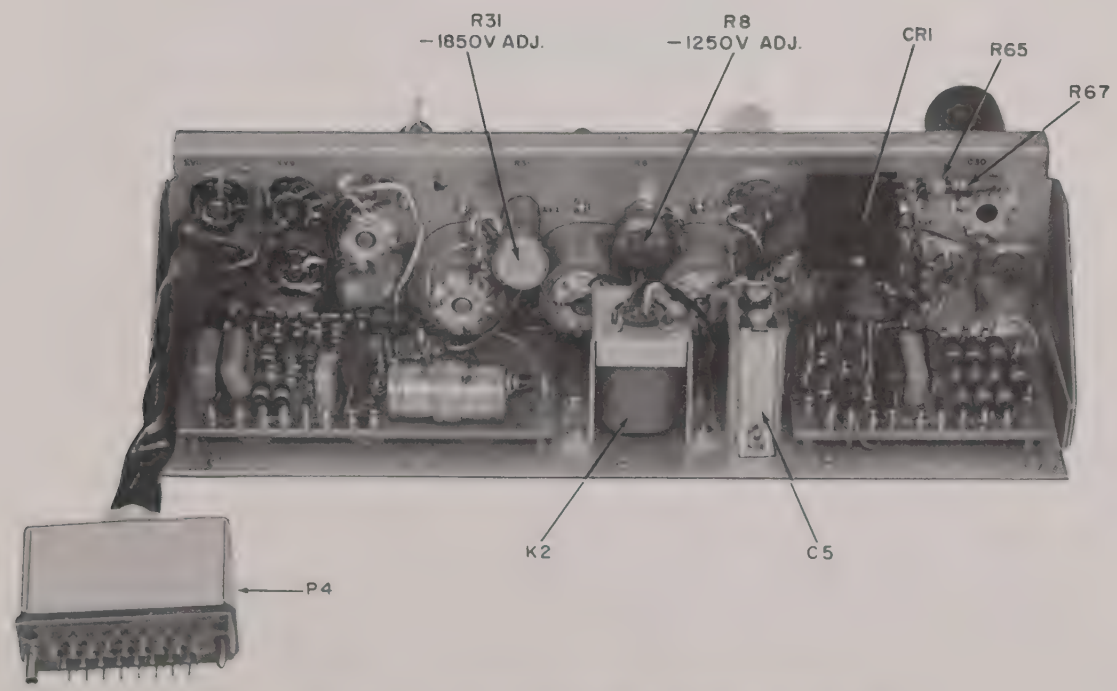


Figure 4-7. Repeller and Beam Chassis, Bottom View

TABLE 4-2. TROUBLE SHOOTING

Step	Symptom	Probable Cause	Possible Remedy
1	Instrument not operating.	Blown line fuses.	Replace.
2	Low operating voltages.	115-230v switch in wrong position.	Place in proper position.
3	No repeller voltage -600 volts.	RECTIFIER V7, SERIES REGULATOR V8.	Replace if defective.
4	Repeller voltage high, no regulation.	D.C. AMPLIFIER V9.	Replace if defective.
5	No -1250v beam voltage.	RECTIFIER V1, RECTIFIER V2, SERIES REGULATOR V3, DELAY RELAY K1 or HOLD RELAY K2.	Replace if defective.
6	Beam voltage high, no regulation.	D.C. AMPLIFIER V4.	Replace if defective.
7	No +210 volts.	RECTIFIER V17, SERIES REGULATOR V18.	Replace if defective.
8	+210 volts high, no regulation.	D.C. AMPLIFIER V19.	Replace if defective.
9	No -108 volts.	RECTIFIER V13, SERIES REGULATOR V14.	Replace if defective.
10	-108 volts high.	D.C. AMPLIFIER V15.	Replace if defective.
11	POWER SET meter cannot be zeroed when MODULATION SELECTOR switch is in ZERO SET position.	P1 not connected. J1 defective. RT101 defective. M1 defective ZERO SET potentiometer R51 defective. COARSE ADJ potentiometer R50 defective or misadjusted.	Connect. Replace. Replace. Replace. Replace or readjust.
12	No power indication on POWER SET meter when MODULATION SELECTOR switch is in CW position.	BEAM CURRENT ADJ R127 defective or misaligned. Defective klystron V102.	Readjust or replace R127. See Table 5-1. NOTE: Check all other trouble symptoms before removing klystron tube from cavity.
13	MODULATION SELECTOR switch in CW position; some indication at various points across the band; intermittent power.	BEAM CURRENT ADJ R127 defective or misaligned. Misalignment of repeller tracking system. Weak klystron tube V102.	Readjust or replace R127. See Table 5-1. Check adjustment per paragraph 5-3d. Replace. See paragraph 4-7.
14	No rf power output at J101 R. F. OUTPUT receptacle; power set readings are available across the band.	R. F. ATTENUATOR probe.	Replace.
15	No output when MODULATION SELECTOR switch is in INT. PULSE, INT. SQ. WV. or FM positions.	+210v power supply and -108 power supply.	Refer to steps 7, 8, 9, and 10.
	In the following modulation trouble shooting conditions, it is assumed that the klystron oscillator is operating satisfactorily in CW. If not, see the above trouble shooting procedure.		
16	(a) When MODULATION SELECTOR switch is in FM position and SYNC & POLARITY switch is in INT. MOD. & SQ. WV. position, no rf FM output is available.	PHANTASTRON RATE GEN V201, COUPLING AMPL V202, PHANTASTRON RATE GEN V203, and FM AMPLITUDE control R201. Check FM J107 for sawtooth waveform output.	Replace defective tubes or components.
	(b) No rf FM output available when using external sync.	PHASE INVERTER V207A, CLIPPER AMPL V207B and/or SCHMITT TRIGGER V208. Check CR208 and items mentioned in part (a).	Replace defective tubes or components.

TABLE 4-2. TROUBLE SHOOTING (Continued)

Step	Symptom	Probable Cause	Possible Remedy
17	(a) No rf pulse available when MODULATION SELECTOR switch is in INT. PULSE position and SYNC & POLARITY SELECTOR switch is in INT. MOD. & SQ. WV. position.	Check all tubes in the modulator section except V207 and V208.	Replace where defective. (See theory section and block diagram.
	(b) No rf pulse output available when using external sync.	Check as in part (a) and include V207, V208, and R238.	Readjust R238 if necessary. (See paragraph 5-8).
18	Unable to vary pulse width when MODULATION SELECTOR switch is in INT. PULSE position.	WIDTH MULTIVIBRATOR V211, MIN WIDTH ADJ R315, and PULSE WIDTH MICROSECONDS R316.	Readjust R315 and/or R309 or replace defective parts. (See paragraphs 5-9 and 5-10.)
19	(a) No rf square wave or fm available when MODULATION SELECTOR switch is in INT. SQ. WV. position and SYNC & POLARITY SELECTOR switch is in INT. MOD. & SQ. WV. position.	See step 17. Check input square wave at J103.	(See theory of operation and block diagram.)
	(b) Poor symmetry in SQ. WV. operation.	SQ. WV. SYMMETRY ADJ. R211 misaligned.	Realign R211 or replace if defective. (See paragraph 5-7.)
20	Klystron oscillator cannot be externally modulated with either a positive or negative signal.	AMPLIFIER V107, AMPLIFIER V108 or PHASE INVERTER V212.	Replace where defective.
21	PRF range cannot be covered in FM, INT. PULSE or INT. SQ. WV. operation.	FREQUENCY CYCLES PER SECOND control R212 and LOW FREQ. ADJ. R217.	(See adjustments procedures, paragraph 5-6.)
22	DELAY range cannot be obtained in internal and external sync.	MIN DELAY ADJ R233, DELAY MICROSECONDS control R234.	(See adjustment procedures, paragraph 5-8.)
23	No UNDELAYED SYNC pulse in internal operation.	PHANTASTRON RATE GEN V201, COUPLING AMP V202, and PHANTASTRON RATE GEN V203.	Replace where defective.
24	No DELAYED SYNC pulse in internal operation.	BLOCKING OSCILLATOR V206A, DELAYED SYNC BLOCKING OSCILLATOR V206B, T201, DELAYED SYNC OUT receptacle J204.	Replace where defective.
		DELAY PHANTASTRON V205, CATHODE FOLLOWER V204A, BUFFER AMPL V204B and the tubes mentioned in step 23.	Replace where defective.

4-5. Checking the DC Power Supplies

The dc voltages, required for proper signal generator operation, are obtained from five electronically regulated power supplies; the beam supply, the repeller supply, the keyer supply, the modulator supply, and the +210V power supply. Refer to section 3 for a detailed discussion, and to figure 5-7 for a complete schematic diagram.

In the event a power supply does not give the normal indication called for in table 4-3 (Power Supply Voltages), refer to table 5-1 (Adjustments, Power Supplies) and to figures 4-3, 4-4, 4-6, 4-7, and 4-8 to locate the defective component in the supply.

TABLE 4-3. POWER SUPPLY VOLTAGES

Power Supply	Test Points From	To	Volts
Beam	C6	Ground	-1250
+210V	Pin 1, 5 of V20	Ground	+210
Repeller	Across C16		-600
	C16	Ground	-1550
	Pin 2, 4, 7 of V12	Ground	-1550
	Pin 7 of V107	Ground	-1400
Modulator	Pin 2, 4, 7 of V16	Ground	-108
Keyer	Across C106		150 to 170

4-6. Checking Relays K101 and K102

The rotation of MODULATION SELECTOR switch S203 to its various positions will cause relays K101 and K102 to energize. Table 4-4 (Relays Energized) indicates which relays will be energized at the various positions of the MODULATION SELECTOR switch. If indications of abnormal operation are present check the relays for dirty or bent contacts.

TABLE 4-4. RELAYS ENERGIZED

Modulation Selector Position	Relay K101	Relay K102
EXT. MOD	Energized	De-energized
INT. PULSE	De-energized	De-energized
INT. SQ. WV.	De-energized	De-energized
FM	De-energized	De-energized
CW	De-energized	Energized
ZERO SET	Energized	Energized

4-7. Replacement of RF Klystron Oscillator

WARNING

This equipment employs high voltages which are dangerous to life. Do NOT attempt to replace the reflex klystron oscillator tube unless the power cord is disconnected from the power input receptacle J1. For access to the equipment, see paragraph 4-2.

a. Removing the Klystron Cover and Klystron Tube. (See figure 4-9.)

1) Loosen clamp strap around klystron cover.
2) While holding klystron cover in one hand, GENTLY pull the tube socket away from the base of the klystron.
3) Use the spanner wrench supplied with the signal generator to loosen the klystron clamp (knurled silver-plated nut), which is threaded to the tuned cavity. DO NOT REMOVE THE KNURLED NUT COMPLETELY. A half turn counterclockwise is sufficient to release its locking action.
4) Grasp the projecting end of the klystron tube, gently rotating it in a clockwise direction while simultaneously withdrawing the tube from its spring-finger holder within the cavity.
5) Carefully insert a replacement klystron tube, (Table 1-1) known to be in good operating condition, into the cavity, and press it all the way in, making sure the repeller cap makes firm contact with the inner conductor.
6) Use the spanner wrench to tighten the klystron clamp nut. DO NOT EXERT PRESSURE.

b. Reassembling the Klystron Cover.

1) Attach the tube socket to the base of the klystron tube. Ensure that the proper tube socket pins are engaged, since this miniature socket may be easily forced into an improper position which will result in the application of improper voltages to the klystron tube.
2) Slide the klystron cover over the socket until the klystron clamp nut is covered. Tighten clamping strap to secure the shield.
3) After replacing the klystron oscillator tube, certain adjustment and alignment procedures must be performed. Refer to table 5-1 for the adjustment of BEAM CURRENT ADJ R127, to paragraph 5-3 for the repeller tracking voltage adjustment and alignment, and to paragraph 5-5 for the frequency dial calibration.

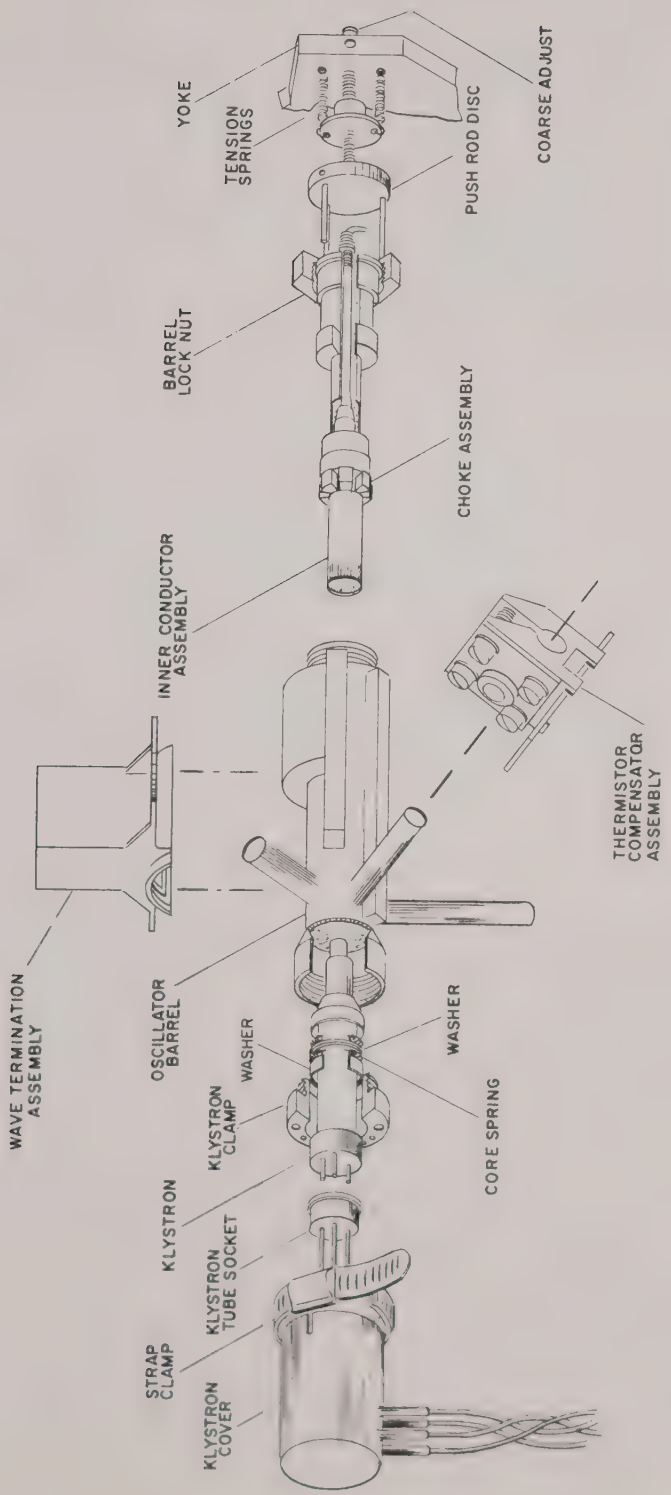


Figure 4-8. Oscillator Cavity, Exploded View

SECTION 5
ADJUSTMENT AND ALIGNMENT

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES VOLTAGES WHICH ARE DANGEROUS TO HUMAN LIFE. REMOVE POWER AND GROUND CIRCUITS BEFORE TOUCHING THEM.

5-1. Power Supply Adjustments

The procedure for checking and adjusting the outputs of the various power supplies is given in table 5-1 (Adjustments, Power Supplies). See figures 4-3 through 4-8 for location of adjustment controls, components, and test points.

5-2. 115-230V Switching System

The 115V-230V input switching system of the unit is normally factory set at 115 volts. If it is desired to use 230 volts as input to the equipment, the internal input switching system must be set as follows:

a. Remove the dust cover as described in paragraph 4-2.
b. The 115-230V switch is a two position switch marked 115-230V. It is located on the basic unit.
c. Simply place the switch in the desired position.

CAUTION

The BEAM CURRENT ADJ R127, in the Keyer Supply is factory adjusted and should not be readjusted except when changing the klystron tube or during trouble shooting. Misalignment of this control can cause severe damage to the klystron tube.

TABLE 5-1. ADJUSTMENTS, POWER SUPPLIES

Circuit	Test Points	Test Equipment	Normal Indication	Adjustment Procedure
Beam Supply		DC voltmeter	-1250	Adjust -1250V ADJ R8. If indication is abnormal, refer to paragraph 3-2 for the theory of operation.
+210V Supply		DC voltmeter	+210 volts	Adjust +210V ADJ R63. If indication is abnormal, refer to paragraph 3-6 for the theory of operation.
Repeller Supply		DC voltmeter	-1850 volts	Adjust -1850V ADJ R31. If indication is abnormal, refer to paragraph 3-3 for the theory of operation.
Keyer Supply		DC voltmeter	+1 volt across R5 with MODULATION SELECTOR switch in CW position.	See paragraph 5-1 CAUTION notice. Adjust BEAM CURRENT ADJ R127. If indication is abnormal, refer to paragraph 3-4 for the theory of operation.
Modulator Supply		DC voltmeter	-108 volts	There is no adjustment for this supply. Its normal output is 108 volts. It is possible, however, to misalign COURSE ADJ R50 to lower the output.
Bridge Circuit	None	None	Meter M1 can be set to ZERO with MODULATION SELECTOR switch in ZERO SET position.	Allow signal generator to remain de-energized for at least one hour. Energize the signal generator and rotate ZERO SET control to its full clockwise position. Adjust COURSE ADJ R50 until the POWER SET meter goes to maximum full scale deflection. If indication is abnormal, refer to paragraph 3-8 for the theory of operation.

5-3. Repeller Voltage Tracking Procedure

Due to the variations in klystron tube characteristics, replacement of the tube will usually require readjustment of the repeller tracking voltages. The repeller voltage tracking procedure assumes that the unit was previously aligned and operating, but that the klystron was changed. The repeller voltages are first adjusted for proper mode trace on the oscilloscope in CW operation, and then in pulse-modulated output. The equipment needed to perform the above is listed in table 5-2.

TABLE 5-2. TEST EQUIPMENT REQUIRED FOR REPELLER TRACKING PROCEDURE

Frequency Range	Oscilloscope	Coaxial Crystal Mount	Reaction Type Frequency Meter Accuracy of 0.1% or Better	Coaxial-to-Waveguide Adapter
4.45 to 5.85 KMC	Dumont 304A	HP420A	PRD-574 3.95 - 5.85 KMC	PRD-357
5.85 to 8.20 KMC	Dumont 304A	HP420A	HP-J530A 5.85 - 8.20 KMC	HP-J281A
8.20 to 11.0 KMC	Dumont 304A	HP420A	HP-X530A 8.20 - 12.4 KMC	HP-X231
ADJUSTMENT OF THE REPELLER TRACKING CIRCUIT DURING INT. PULSE MODULATION REQUIRES THE USE OF THE FOLLOWING EQUIPMENT.				
4.45 to 11.0 KMC	Tektronix 531A	HP420A	As above for the various ranges.	As above for the various ranges.

a. Test Set-up.

1) Remove the rf chassis from the main frame as described in paragraph 4-2 and connect all plugs. PROCEED WITH CAUTION. Set up the equipment while operating power is disconnected. See figure 5-1 for this test set-up. The Modulator Phase Shifting Circuit MK-1 is not supplied with this equipment. It can be fabricated from the schematic diagram, figure 5-2, or purchased from Polarad Electronics Corporation.

2) Connect one end of the coaxial crystal mount, with dc return to the vertical input of a high gain oscilloscope, and the opposite end to the coaxial-to-waveguide adapter.

3) Connect a coaxial-to-waveguide adapter to the signal generator and place a reaction type frequency meter having an accuracy of 0.1% or better, between the two adapters.

4) See table 5-2 for the equipment required at the different frequency ranges.

b. Control Settings for Model PMX.

1) With MODULATION SELECTOR switch S203 at its CW position, apply operating power to the signal generator and allow at least a 20-minute warmup period.

2) Rotate SYNC & POLARITY SELECTOR switch S201 to its INT. MOD. & SQ. WV. position.

c. Track Potentiometer Adjustments (CW).

1) After the test equipment has been set up and the controls set as directed in the preceeding steps, connect the negative lead of a 20,000 ohm-per-volt voltmeter to the repeller connection J105, and the positive lead to pin 3 of TRACKING POT R101 and proceed as directed in table 5-3.

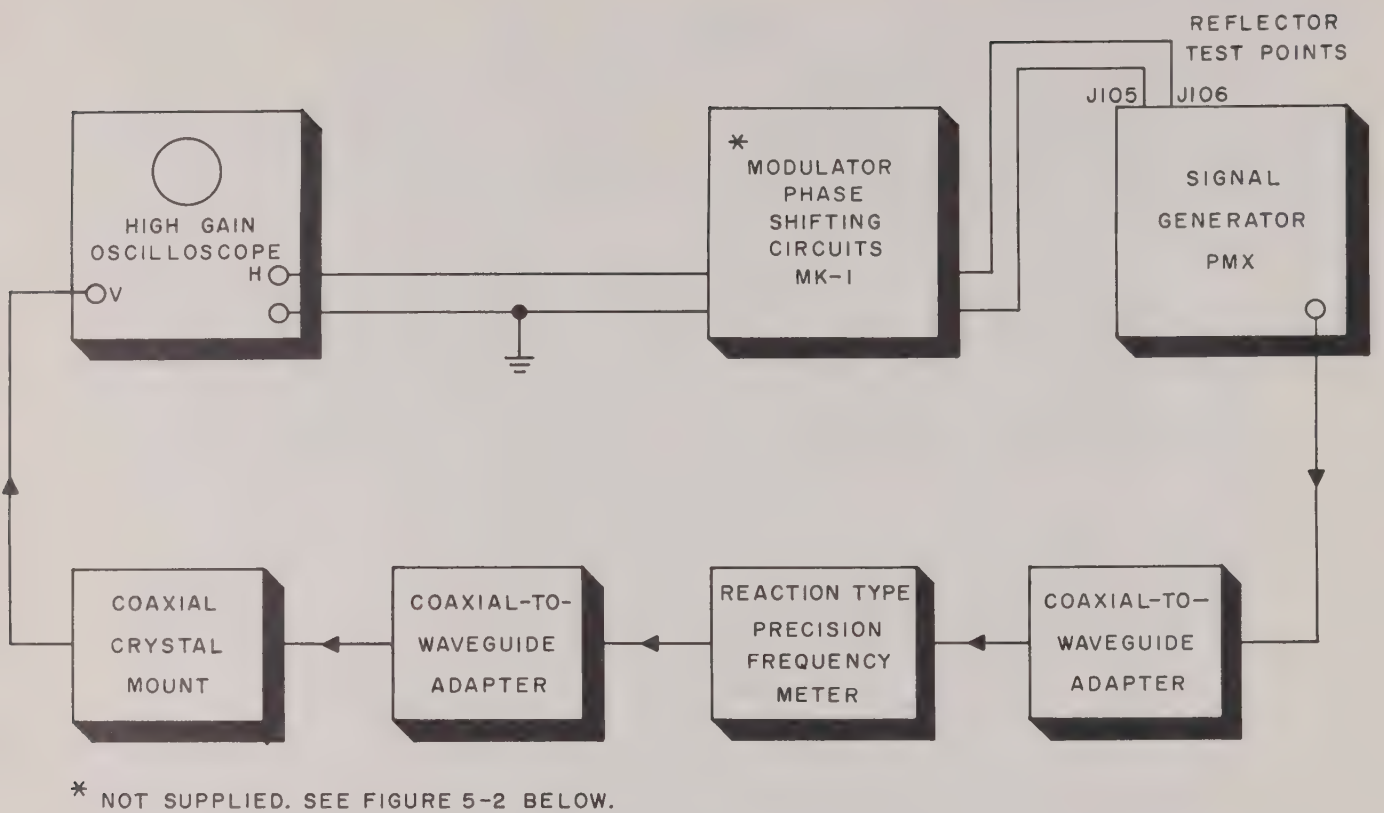


Figure 5-1. Repeller Voltage Tracking, Test Set-up

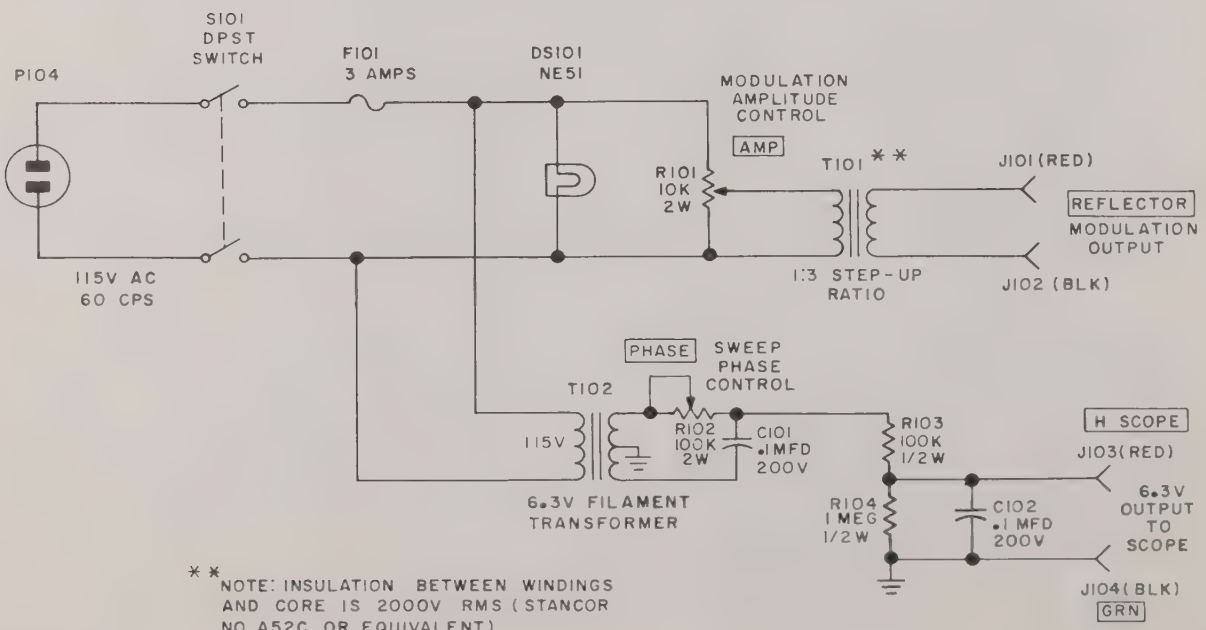


Figure 5-2. Modulator Phase Shifting Circuit, MK-1, Schematic Diagram

TABLE 5-3. TRACKING ADJUSTMENTS

Step	Set Frequency Dial To:	Indication Voltage*	Mode	If indication is not correct, adjust:
		G-48 HEAD		
1	4560 MC	60 V	2-3/4	LOW POTENTIOMETER - R102
2	5000 MC	160 V	2-3/4	TRACK 1 and 2 - R103, R104
3	5600 MC	225 V	2-3/4	TRACK 1 - R104
4	6000 MC	275 V	2-3/4	LOW MODE POTENTIOMETER - R107
5	6400 MC	325 V	2-3/4	LOW MODE POTENTIOMETER - R107
6	6600 MC	100 V	4-3/4	TRACK 3 - R105 and HIGH MODE POTENTIOMETER - R108 **
7	7000 MC	150 V	4-3/4	TRACK 3 - R105 **
8	7600 MC	200 V	4-3/4	TRACK 3 - R105 **
9	8000 MC	225 V	4-3/4	HIGH POTENTIOMETER - R106
		G7-11 HEAD		
1	7000 MC	140 V	3-3/4	LOW POTENTIOMETER - R102
2	7600 MC	180 V	3-3/4	TRACK 1 - R103 and TRACK 2 - R104
3	8000 MC	220 V	3-3/4	TRACK 2 - R104
4	8400 MC	280 V	3-3/4	LOW MODE POTENTIOMETER - R107
5	8800 MC	135 V	4-3/4	HIGH MODE POTENTIOMETER - R108
6	9000 MC	145 V	4-3/4	TRACK 3 - R105 **
7	9600 MC	185 V	4-3/4	TRACK 3 - R105 **
8	10,000 MC	210 V	4-3/4	TRACK 3 - R105 **
9	10,600 MC	250 V	4-3/4	TRACK 3 - R105 **
10	11,000 MC	295 V	4-3/4	HIGH POTENTIOMETER - R106

* Approximate. There may be a variation of ±20% due to the difference in klystron tubes.

** On units bearing serial numbers 156 and higher, R105 (TRACK 3) has been eliminated. The adjustments previously made with this potentiometer may be obtained by adjusting HIGH MODE POTENTIOMETER - R108 and HIGH POTENTIOMETER - R106 to the proper mode and voltage indication.

2) Recheck the repeller voltages at the high and low dial frequencies by repeating steps 1 and 2 of table 5-3. Upon completion, check the intermediate tracking points.

NOTE

If the klystron has been replaced, the above procedure should afford correct repeller tracking. Failure to track properly may indicate a defective replacement klystron.

3) The repeller voltage must now be rechecked, as directed above (step 2), because of the interacting effects of the adjustments. Minor adjustments are to be made, as necessary, to complete the alignment procedure, with the signal generator producing continuous-wave output signals.

e. Track Potentiometer Adjustments (Pulse-Modulated Output.

Recheck the repeller voltage tracking throughout the tuning range as follows:

1) Rotate MODULATION SELECTOR switch to its INT. PULSE position.

2) Set SYNC & POLARITY SELECTOR switch to its INT. MOD. & SQ. WV. position.

3) Set FREQUENCY MULTIPLIER and FREQUENCY CYCLES PER SECOND controls to produce a pulse repetition frequency of approximately 1,000 pps.

4) Check for pulse-modulated output throughout the equipment frequency range.

5-4. Tracking Adjustment after Replacement of a Track Potentiometer

After the replacement of one of the track potentiometers, R102 through R106, set the arm of the replacement potentiometer to the center of its travel and proceed as directed in paragraph 5-3.

NOTE

If trouble is experienced in the alignment of the repeller tracking circuit, it may be localized by measuring the voltage between test points R108, Pin 3 and R107, Pin 3. The voltage should be 600 volts dc.

5-5. Frequency Dial Calibration

a. Perform the test set-up as described in paragraph 5-3A, using the test equipment indicated in table 5-2. If the accuracy of the frequency dial falls outside the 1% tolerance at any point over the tuning range, fine adjustments can be made by means of the adjustable tuning cam shown in figure 5-3. Five eccentric bolts and nuts on the cam are to be adjusted as described below:

1) Turn the SIGNAL FREQUENCY control so that the cam follower is at a fixed section of the

tuning cam adjacent to the two small holes which terminate the arc on the cam. Tune the wavemeter to 9000 mc. The FREQUENCY IN MEGACYCLES dial will be at this frequency.

2) A mode pattern should appear on the oscilloscope. A dip should appear at the center of the mode pattern if the oscillator output is at 9000 mc.

WARNING

WHEN SERVICING CARE SHOULD BE EXERCISED IN ADJUSTING THE ATTENUATOR AND THERMISTOR PROBES. FORCIBLY PUSHING THE PLUNGER FORWARD BEYOND ITS NORMAL MECHANICAL STOP WILL CAUSE SEVERE DAMAGE TO THE INTERNAL KLYSTRON CAVITY THEREBY DESTROYING THE OVERALL CALIBRATION OF THE EQUIPMENT.

3) Frequency correction is made by adjusting the push-rods which are part of the choke assembly. This is the ONLY time the push-rods will be adjusted. Use the Spline wrench supplied, to loosen the three set-screws on the push-rod disc. (See figure 4-9.) GENTLY and SLOWLY move the push-rods up or down so that the oscillator frequency changes enough to move the dip to the center of the mode pattern as shown in figure 5-4. Once the dip is centered, a reference point has been established on the cam with respect to the dial. Tighten the set-screws after this has been accomplished. Recheck for dip centering on the mode pattern.

4) Next, the remainder of the oscillator frequency range is calibrated. This is accomplished by using the five adjustment bolts located along the periphery of the cam. (See figure 5-3.) Since the bolts are off-set, adjusting them slightly alters the shape of the periphery of the cam.

CAUTION

NEVER ATTEMPT TO ADJUST ANY BOLT ON THE TUNING CAM UNLESS ALL THE BOLTS ON THAT SECTION OF THE CAM ARE FIRST LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB CAMS TO THE CAM.

5) Rotate the SIGNAL FREQUENCY control until the FREQUENCY IN MEGACYCLES dial indicates 10,000 mc. The cam follower will be directly opposite eccentric adjustment no. 4.

6) To determine the oscillator frequency, set the wavemeter to the above frequency. If the wavemeter dip is not in the center of the mode pattern, adjusting the bolts will shift the mode pattern slightly.

7) This procedure is repeated at each of the five

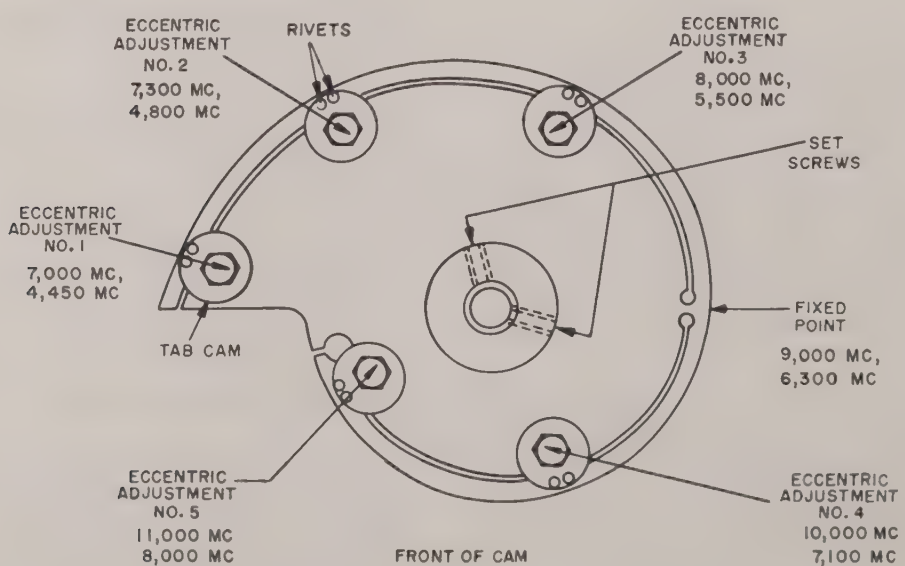


Figure 5-3. Oscillator Adjustable Tuning Cam, Component Location Diagram (frequency adjustment points for the G48 and G711 RF Heads)

adjustment bolts as listed below in the following order:

Tuning Head G-711	
2nd step:	Eccentric No. 5
3rd step:	Eccentric No. 3
4th step:	Eccentric No. 2
5th step:	Eccentric No. 1

Tuning Head G-48	
2nd step:	Eccentric No. 5
3rd step:	Eccentric No. 3
4th step:	Eccentric No. 2
5th step:	Eccentric No. 1

8) After making each adjustment, tighten each cam nut using two open-end wrenches. Both the hexhead nuts and bolts are 5/16 inches wide across the flats.

9) After the last adjustment has been made, recheck the previous four adjustments to be sure that they have not been disturbed by subsequent adjustments. Upon completion, check the calibration of the oscillator at 25 megacycle intervals throughout the entire frequency range. If all points are within 0.5% of the wavemeter readings, the oscillator is correctly calibrated.

5-6. Setting the LOW FREQ ADJ R217

a. Connect the signal generator and test equipment as shown in figure 5-5A. Energize the equipment and allow a fifteen minute warm-up period.

b. Set FREQUENCY MULTIPLIER control to X10 position. Set FREQUENCY CYCLES PER SECOND control to position 1. Set MODULATION SELECTOR switch to INT. PULSE position. Set SYNC & POLARITY SELECTOR switch to INT. MOD. & SQ. WV. position.

c. After the above settings have been made, check for a 10 cps pulse repetition rate. If the pulse repetition rate does not fall on 10 cps then adjust the LOW FREQ. ADJ. R217. The high end of the repetition rate range will automatically fall in and track correctly when LOW FREQ. ADJ. R217 is properly adjusted.

5-7. Setting the SQ. WV. SYMMETRY ADJ R211

a. Connect the signal generator and test equipment as shown in figure 5-5B.

b. Set FREQUENCY MULTIPLIER control to X1000 position. Set FREQUENCY CYCLES PER SECOND control to position 5. Set MODULATION SELECTOR switch to INT. SQ. WV. position. Set SYNC & POLARITY SELECTOR switch to INT. MOD & SQ. WV. position.

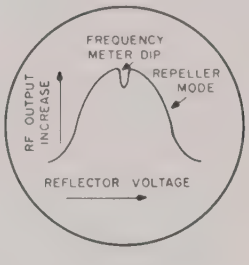
c. Using the coaxial crystal detector, feed the detected rf output signal to the Tektronix Model 531 oscilloscope.

d. Adjust SQ. WV. SYMMETRY ADJ. R211 until the pulse width of the waveform displayed on the oscilloscope is 50% of the repetition rate or when the on and off periods are equal.

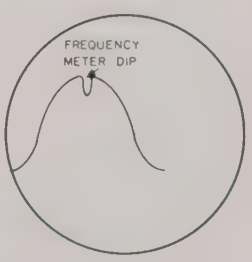
e. Lock the shaft of R211 in the desired position by tightening the locknuts. Recheck the symmetry of the square wave.

5-8. Setting the MIN DELAY ADJ R233

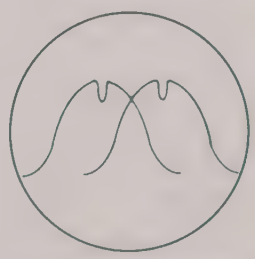
a. Connect the signal generator and test equipment as shown in figure 5-5C.



MODE PATTERN CENTERED



MODE PATTERN NOT CENTERED



PHASE SHIFT CONTROL IMPROPERLY ADJUSTED

Figure 5-4. Typical Mode Patterns

b. Set SYNC & POLARITY SELECTOR switch to INT. PULSE position. Set DELAY MULTIPLIER to X1 position. Set DELAY MICROSECONDS to position 2.

c. Trigger the oscilloscope with the signal from the UNDELAYED SYNC. OUT connector. Feed the DELAYED SYNC. OUT to the vertical input of the oscilloscope.

d. Adjust MIN DELAY ADJ R233 for 2 microseconds spacing between the undelayed and delayed triggers. Lock the shaft in the desired position by tightening the locknut. Recheck the spacing after the locknut has been secured.

e. Potentiometer R238 is factory adjusted. If adjustment is required due to the absence of a delayed sync pulse output, then adjust potentiometer R238 to the point where Blocking Osc. V206B conducts but does not free-run.

5-9. Setting the MIN WIDTH ADJ R315

a. Connect the signal generator and test equipment as shown in figure 5-5B.

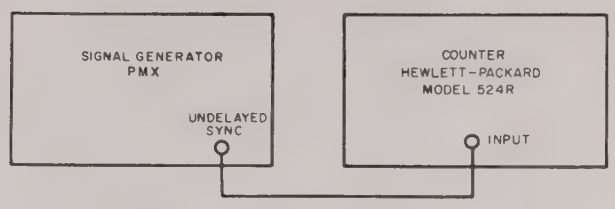
b. Set the signal generator for internal pulse operation. Set PULSE WIDTH control to 0.2 microsecond.

c. Couple the rf output of the equipment to the vertical input of the Tektronix Model 531 oscilloscope through the Hewlett-Packard 420A coaxial crystal detector having a 250 ohm termination.

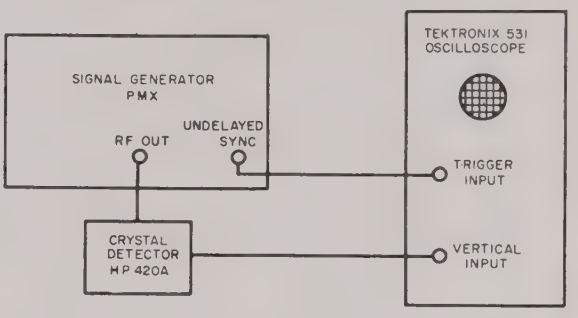
d. Adjust MIN WIDTH ADJ R315 for a 0.2 microsecond pulse width. Lock the potentiometer shaft lock in the desired position. Recheck the pulse width after the lock has been tightened.

5-10. Setting the BIAS ADJ R309

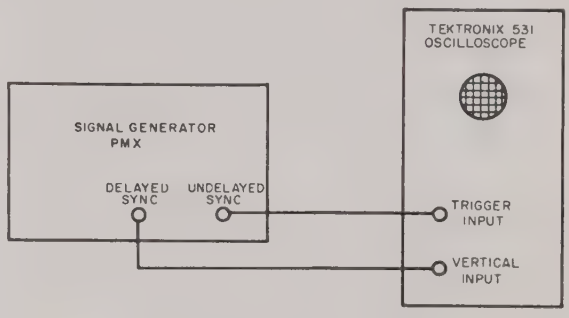
R309 controls the grid bias of multivibrator V211, and is factory adjusted. If readjustment is required, R309 should be set so that there is approximately 20 volts on the grid of V211 and so that the pulse does not free-run or break up in any way. A good clean pulse should be observed on the oscilloscope at both the grid and plate of V211.



(A) TEST SET-UP FOR LOW FREQ ADJ R217



(B) TEST SET-UP FOR SYMMETRY ADJ R211 AND MIN WIDTH ADJ R315

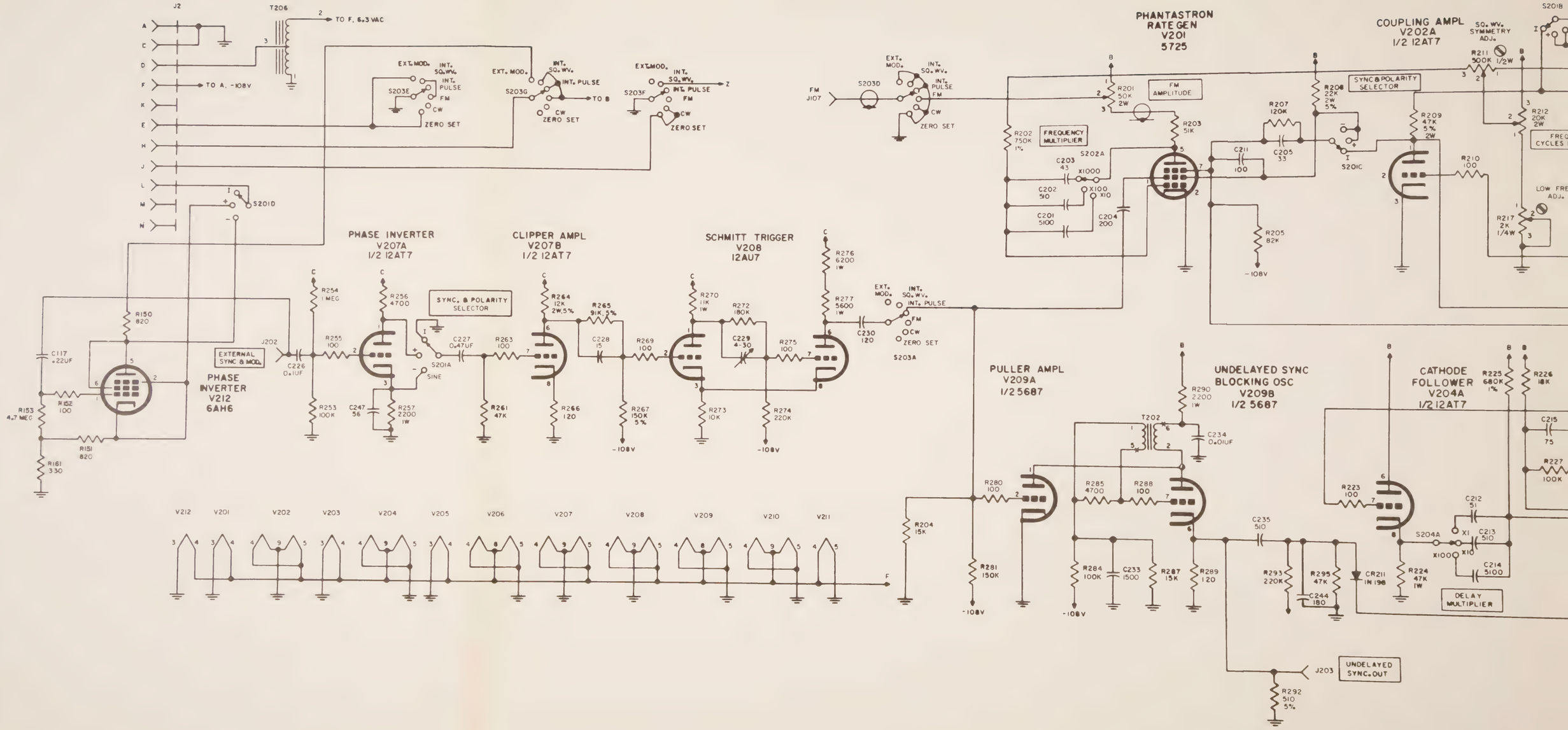


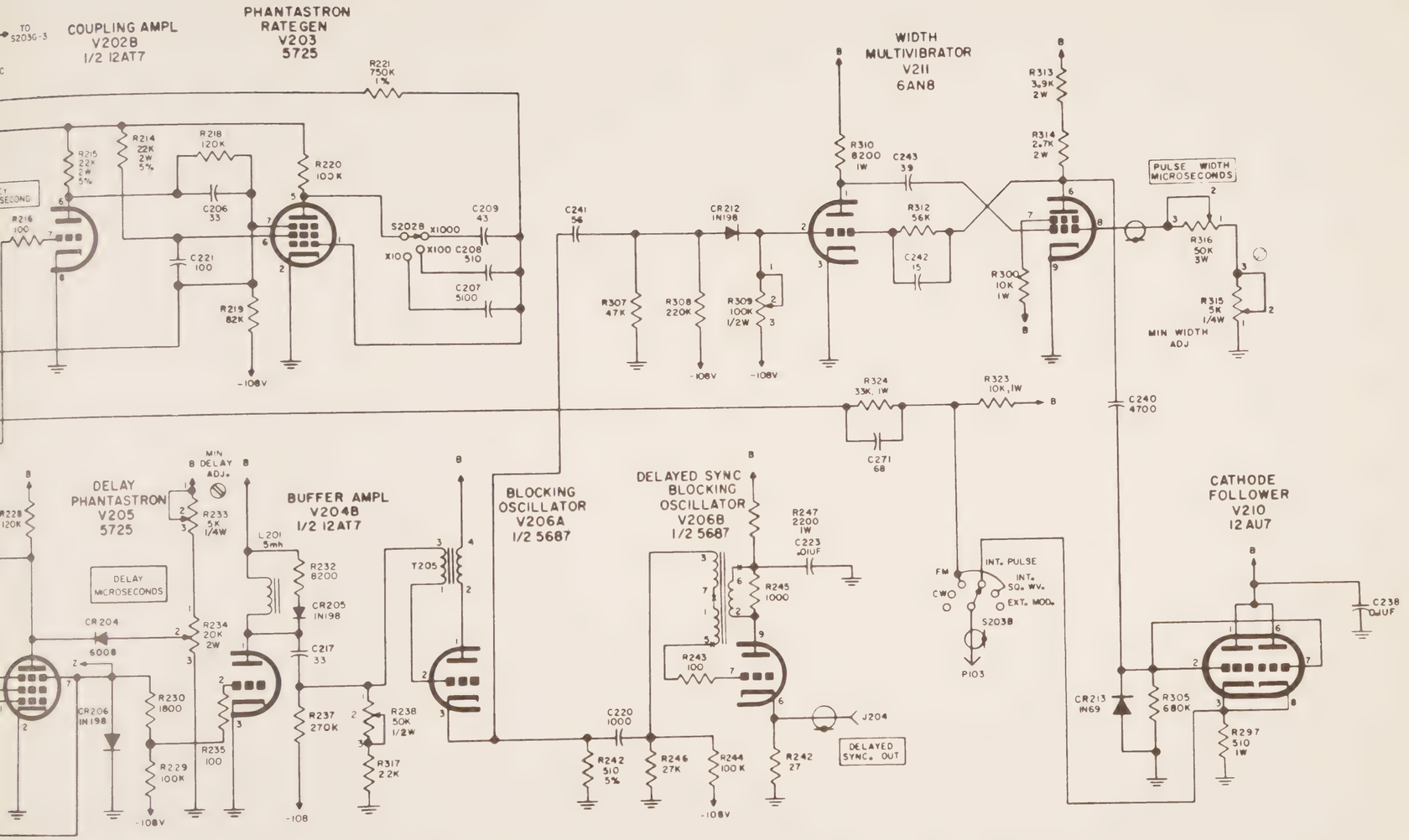
(C) TEST SET-UP MIN DELAY ADJ R233

Figure 5-5. Adjustments, Test Set Up

5-11. Setting the BIAS ADJ R131

R131 controls the grid bias of pulse amplifier V107. If readjustment becomes necessary, the control should be set so that the pulse or square wave does not free-run or break up when the modulation selector switch is in the INT PULSE, INT SQ WAVE or FM positions.

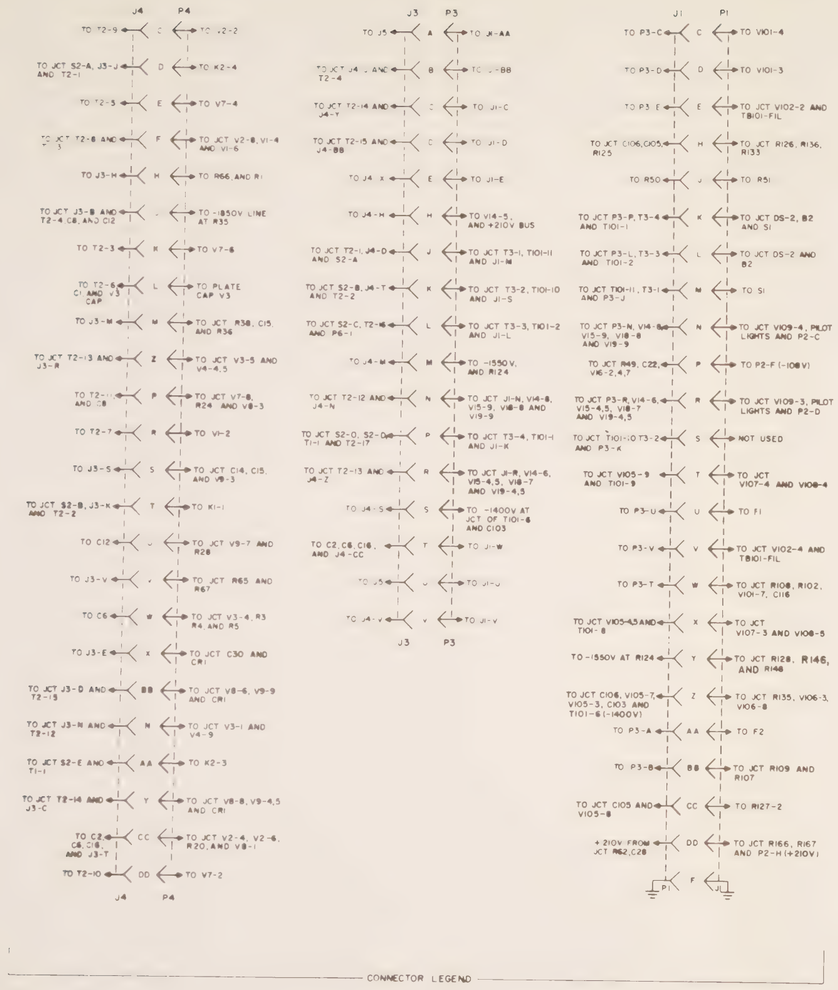

J2
T206
TO F, 6.3 VAC
TO A, -108V
EXT. MOD.
INT. SQ. WV.
INT. PULSE
FM
CW
ZERO SET
S203E
S203G
S203F
TO B
Z
S201D
PHASE INVERTER
V207A
1/2 12AT7
CLIPPER AMPL
V207B
1/2 12AT7
SCHMITT TRIGGER
V208
12AU7
PHANTASTRON
RATE GEN
V201
5725
COUPLING AMPL
V202A
1/2 12AT7
SQ. WV. SYMMETRY ADJ.
S201B
FM AMPLITUDE
FREQUENCY MULTIPLIER
SYNC & POLARITY SELECTOR
S202A
S201C
FREQ CYCLES
LOW FRE ADJ.
EXTERNAL SYNC & MOD.
J202
PHASE INVERTER
V212
6AH6
SINE
S201A
S203A
PULLER AMPL
V209A
1/2 5687
UNDELAYED SYNC BLOCKING OSC
V209B
1/2 5687
CATHODE FOLLOWER
V204A
1/2 12AT7
S204A
DELAY MULTIPLIER
CR211 IN198
J203
UNDELAYED SYNC. OUT
V212 V201 V202 V203 V204 V205 V206 V207 V208 V209 V210 V211
-108V

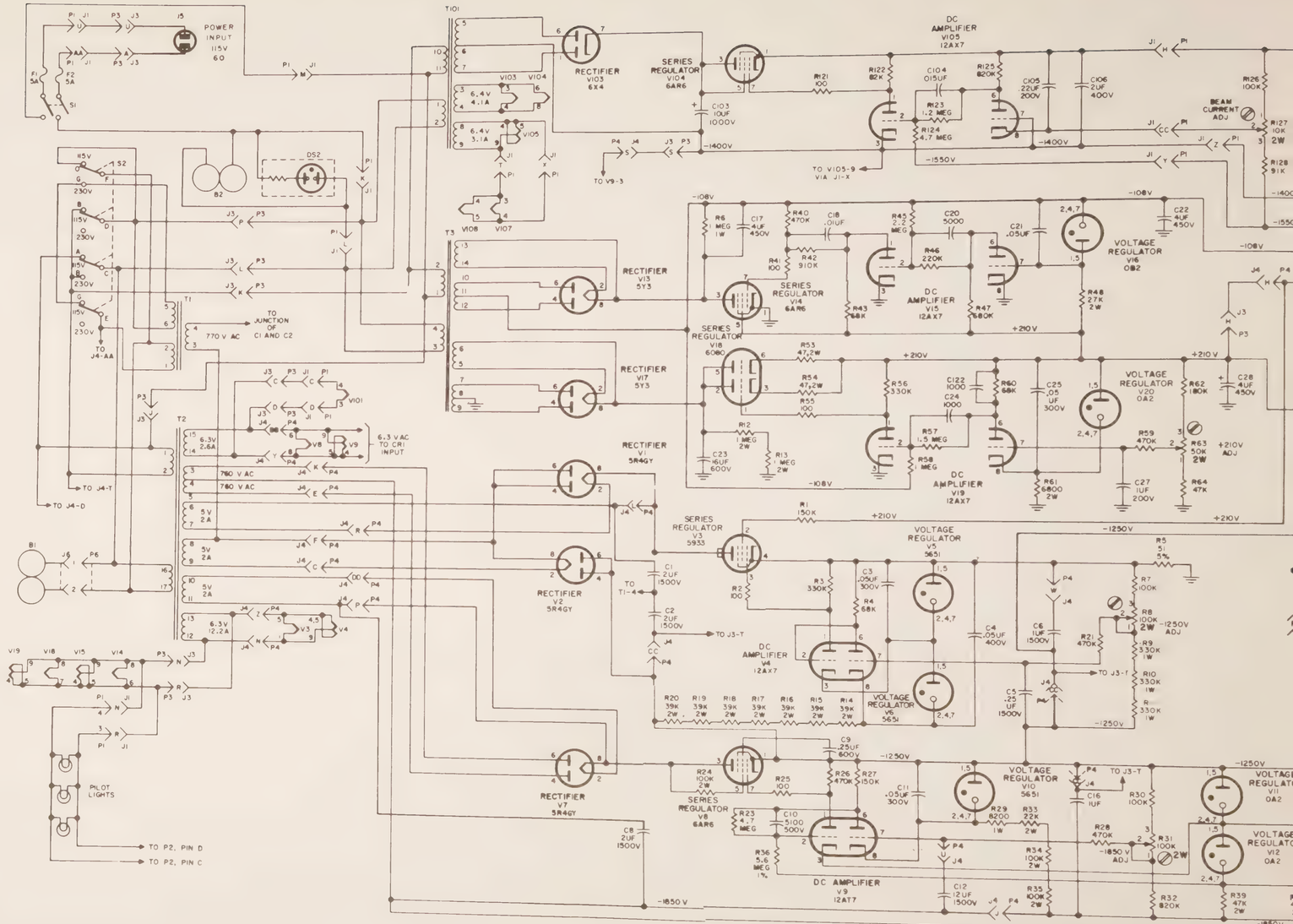


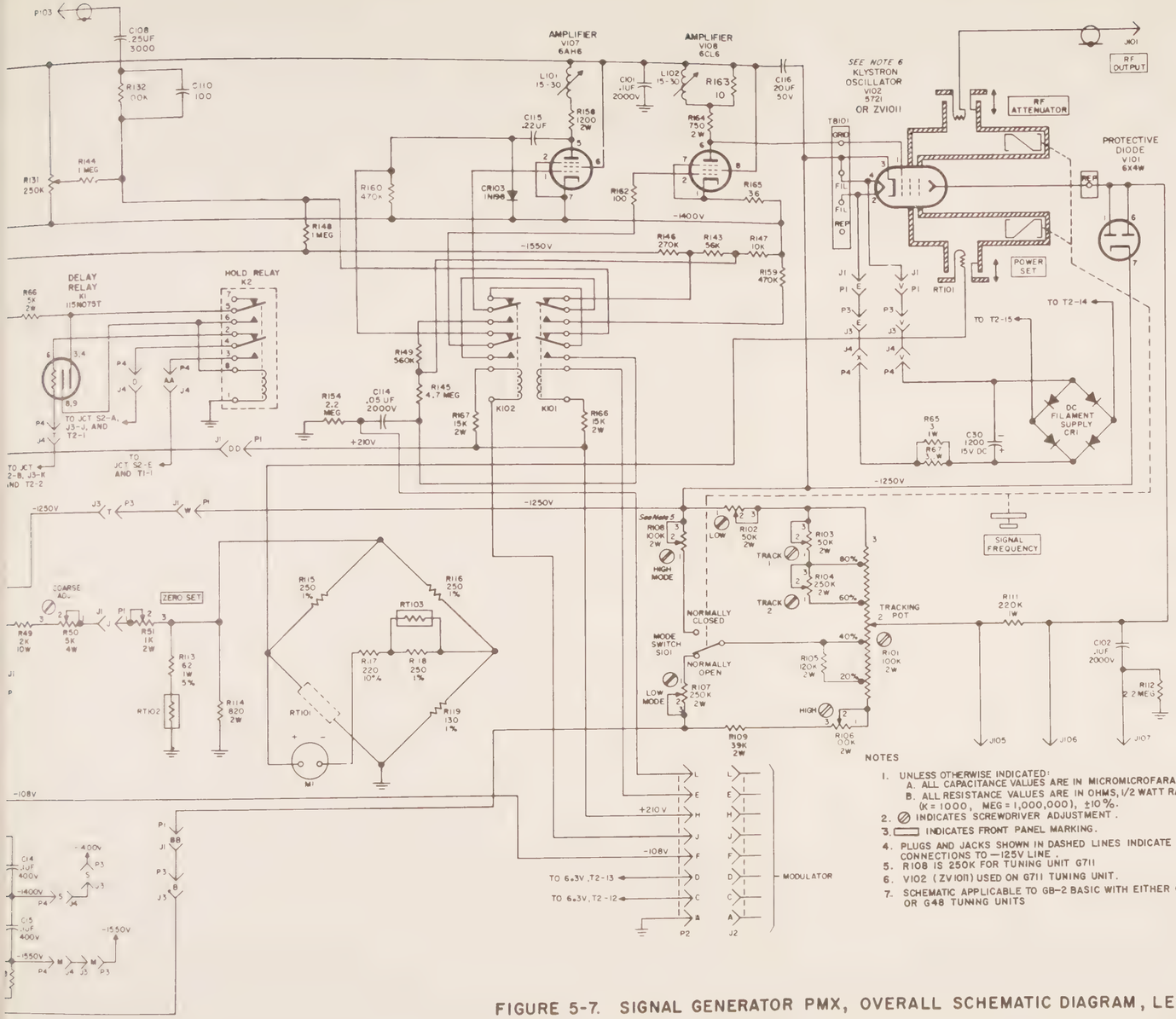
NOTES:—

1. ALL RESISTORS 10%, 1/2W UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS IN UUF
3. B SIGNIFIES ALL LINES GOING TO S203G-3
4. C SIGNIFIES ALL LINES GOING TO S201B

FIGURE 5-6. MODULATOR SECTION, SCHEMATIC DIAGRAM


J4 P4
TO T2-9 C TO J2-2
TO JCT S2-A, J3-J AND T2-1 D TO K2-4
TO T2-5 E TO V7-4
TO JCT T2-8 AND J3 F TO JCT V2-8, V1-4 AND V1-6
TO J3-H H TO R66 AND R1
TO JCT J3-B AND T2-4 C8, AND C12 J TO -1850V LINE AT R35
TO T2-3 K TO V7-6
TO T2-6 C1 AND V3 CAP L TO PLATE CAP V3
TO J3-M M TO JCT R38, C15 AND R36
TO JCT T2-13 AND J3-R Z TO JCT V3-5 AND V4-4,5
TO T2-11 AND C8 P TO JCT V7-8, R24 AND V8-3
TO T2-7 R TO V1-2
TO J3-S S TO JCT C14, C15, AND V9-3
TO JCT S2-B, J3-K AND T2-2 T TO K1-1
TO C12 U TO JCT V9-7 AND R28
TO J3-V V TO JCT R65 AND R67
TO C6 W TO JCT V3-4, R3 R4 AND R5
TO J3-E X TO JCT C30 AND CR1
TO JCT J3-D AND T2-15 BB TO JCT V8-6, V9-9 AND CR1
TO JCT J3-N AND T2-12 N TO JCT V3-1 AND V4-9
TO JCT S2-E AND T1-1 AA TO K2-3
TO JCT T2-14 AND J3-C Y TO JCT V8-8, V9-4,5 AND CR1
TO C2, C8, C18, AND J3-T CC TO JCT V2-4, V2-6, R20, AND V8-1
TO T2-10 DD TO V7-2
J4 P4
J3 P3
TO J5 A TO J1-AA
TO JCT J4-J AND T2-4 B TO J1-BB
TO JCT T2-14 AND J4-Y C TO J1-C
TO JCT T2-15 AND J4-BB D TO J1-D
TO J4-X E TO J1-E
TO J4-H H TO V14-5, AND +210V BUS
TO JCT T2-1, J4-D AND S2-A J TO JCT T3-1, T101-11 AND J1-M
TO JCT S2-B, J4-T AND T2-2 K TO JCT T3-2, T101-10 AND J1-S
TO JCT S2-C, T2-16 AND P6-1 L TO JCT T3-3, T101-2 AND J1-L
TO J4-M M TO -1550 V. AND R124
TO JCT T2-12 AND J4-N N TO JCT J1-N, V14-8, V15-9, V18-8 AND V19-9
TO JCT S2-D, S2-D AND T1-1 AND T2-17 P TO JCT T3-4, T101-1 AND J1-K
TO JCT T2-13 AND J4-Z R TO JCT J1-R, V14-6, V15-4,5, V18-7 AND V19-4,5
TO J4-S S TO -1400V AT JCT OF T101-6 AND C103
TO C2, C8, C18, AND J4-CC T TO J1-W
TO J5 U TO J1-U
TO J4-V V TO J1-V
J1 P1
TO P3-C C TO V101-4
TO P3-D D TO V101-3
TO P3-E E TO JCT V102-2 AND T8101-FIL
TO JCT C106, C105, R125 H TO JCT R126, R136, R133
TO R50 J TO R51
TO JCT P3-P, T3-4 AND T101-1 K TO JCT DS-2, B2 AND S1
TO JCT P3-L, T3-3 AND T101-2 L TO JCT DS-2 AND B2
TO JCT T101-11, T3-1 AND P3-J M TO S1
TO JCT P3-N, V14-8, V15-9, V18-8 AND V19-9 N TO JCT V109-4, PILOT LIGHTS AND P2-C
TO JCT R49, C22, V16-2,4,7 P TO P2-F (-108V)
TO JCT P3-R, V14-6, V15-4,5, V18-7 AND V19-4,5 R TO JCT V109-3, PILOT LIGHTS AND P2-D
TO JCT T101-10, T3-2 AND P3-K S NOT USED
TO JCT V105-9 AND T101-9 T TO JCT V107-4 AND V108-4
TO P3-U U TO F1
TO P3-V V TO JCT V102-4 AND T8101-FIL
TO P3-T W TO JCT R108, R102, V101-7, C116
TO JCT V105-4,5 AND T101-8 X TO JCT V107-3 AND V108-5
TO -1550V AT R124 Y TO JCT R128, R146, AND R148
TO JCT C106, V105-7, V105-3, C103 AND T101-6 (-1400V) Z TO JCT R135, V106-3, V106-8
TO P3-A AA TO F2
TO P3-B BB TO JCT R109 AND R107
TO JCT C105 AND V105-8 CC TO R127-2
+210V FROM JCT R62, C28 DD TO JCT R166, R167 AND P2-H (+210V)
P1 J1
CONNECTOR LEGEND


POWER INPUT 115V 60
F1 5A
F2 5A
S1
S2
DS2
B2
B1
T1
T2
T3
TO JUNCTION OF C1 AND C2
770 V AC
760 V AC
760 V AC
6.3V 2.6A
5V 2A
5V 2A
5V 2A
6.3V 12.2A
4.5
6.3 VAC TO CRI INPUT
TO J4-T
TO J4-D
TO J4-AA
PILOT LIGHTS
TO P2, PIN D
TO P2, PIN C
T101
V101 V102 V103 V104 V105 V106 V107 V108
6.4V 4.1A
6.4V 3.1A
RECTIFIER V103 6X4
RECTIFIER 5Y3
RECTIFIER V13 5Y3
RECTIFIER V17 5Y3
RECTIFIER V1 5R4GY
RECTIFIER V2 5R4GY
RECTIFIER V7 5R4GY
SERIES REGULATOR V104 6AR6
SERIES REGULATOR V14 6AR6
SERIES REGULATOR V18 6080
SERIES REGULATOR V3 5933
SERIES REGULATOR V8 6AR6
DC AMPLIFIER V105 12AX7
DC AMPLIFIER V15 12AX7
DC AMPLIFIER V19 12AX7
DC AMPLIFIER V4 12AX7
DC AMPLIFIER V9 12AT7
VOLTAGE REGULATOR V16 OB2
VOLTAGE REGULATOR V20 0A2
VOLTAGE REGULATOR V5 5651
VOLTAGE REGULATOR V6 5651
VOLTAGE REGULATOR V10 5651
VOLTAGE REGULATOR V11 0A2
VOLTAGE REGULATOR V12 0A2
BEAM CURRENT ADJ
-1400V
-1550V
-108V
+210V
-1250V
-1850V
TO V105-9 VIA J1-X
TO V9-3
TO J3-T
TO T1-4
TO J4-CC
TO J4-BB
TO J4-Y
TO J4-Z
TO J4-W
TO J4-V
TO J4-U
TO J4-S
TO J4-R
TO J4-P
TO J4-N
TO J4-M
TO J4-K
TO J4-J
TO J4-H
TO J4-F
TO J4-E
TO J4-C
TO J4-A
TO J3-T
TO J3-S
TO J3-P
TO J3-N
TO J3-M
TO J3-L
TO J3-K
TO J3-J
TO J3-H
TO J3-F
TO J3-E
TO J3-D
TO J3-C
TO J3-B
TO J3-A
TO J1-AA
TO J1-BB
TO J1-C
TO J1-D
TO J1-E
TO J1-H
TO J1-J
TO J1-K
TO J1-L
TO J1-M
TO J1-N
TO J1-P
TO J1-R
TO J1-S
TO J1-U
TO J1-V
TO J1-W
TO J1-Z
TO J1-CC
TO J1-DD
TO J1-EE
TO J1-FF
TO J1-HH
TO J1-JJ
TO J1-KK
TO J1-LL
TO J1-MM
TO J1-NN
TO J1-PP
TO J1-RR
TO J1-SS
TO J1-TT
TO J1-UU
TO J1-VV
TO J1-WW
TO J1-XX
TO J1-YY
TO J1-ZZ
TO J1-AAA
TO J1-BBB
TO J1-CCC
TO J1-DDD
TO J1-EEE
TO J1-FFF
TO J1-HHH
TO J1-JJJ
TO J1-KKK
TO J1-LLL
TO J1-MMM
TO J1-NNN
TO J1-PPP
TO J1-RRR
TO J1-SSS
TO J1-TTT
TO J1-UUU
TO J1-VVV
TO J1-WWW
TO J1-XXX
TO J1-YYY
TO J1-ZZZ



NOTES

1. UNLESS OTHERWISE INDICATED:
   A. ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
   B. ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT RATING, (K = 1000, MEG = 1,000,000), ±10%.
2. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
3. ▭ INDICATES FRONT PANEL MARKING.
4. PLUGS AND JACKS SHOWN IN DASHED LINES INDICATE CONNECTIONS TO −125V LINE.
5. R108 IS 250K FOR TUNING UNIT G711
6. V102 (ZV1011) USED ON G711 TUNING UNIT.
7. SCHEMATIC APPLICABLE TO GB-2 BASIC WITH EITHER G711 OR G48 TUNNG UNITS

FIGURE 5-7. SIGNAL GENERATOR PMX, OVERALL SCHEMATIC DIAGRAM, LESS MODULATOR

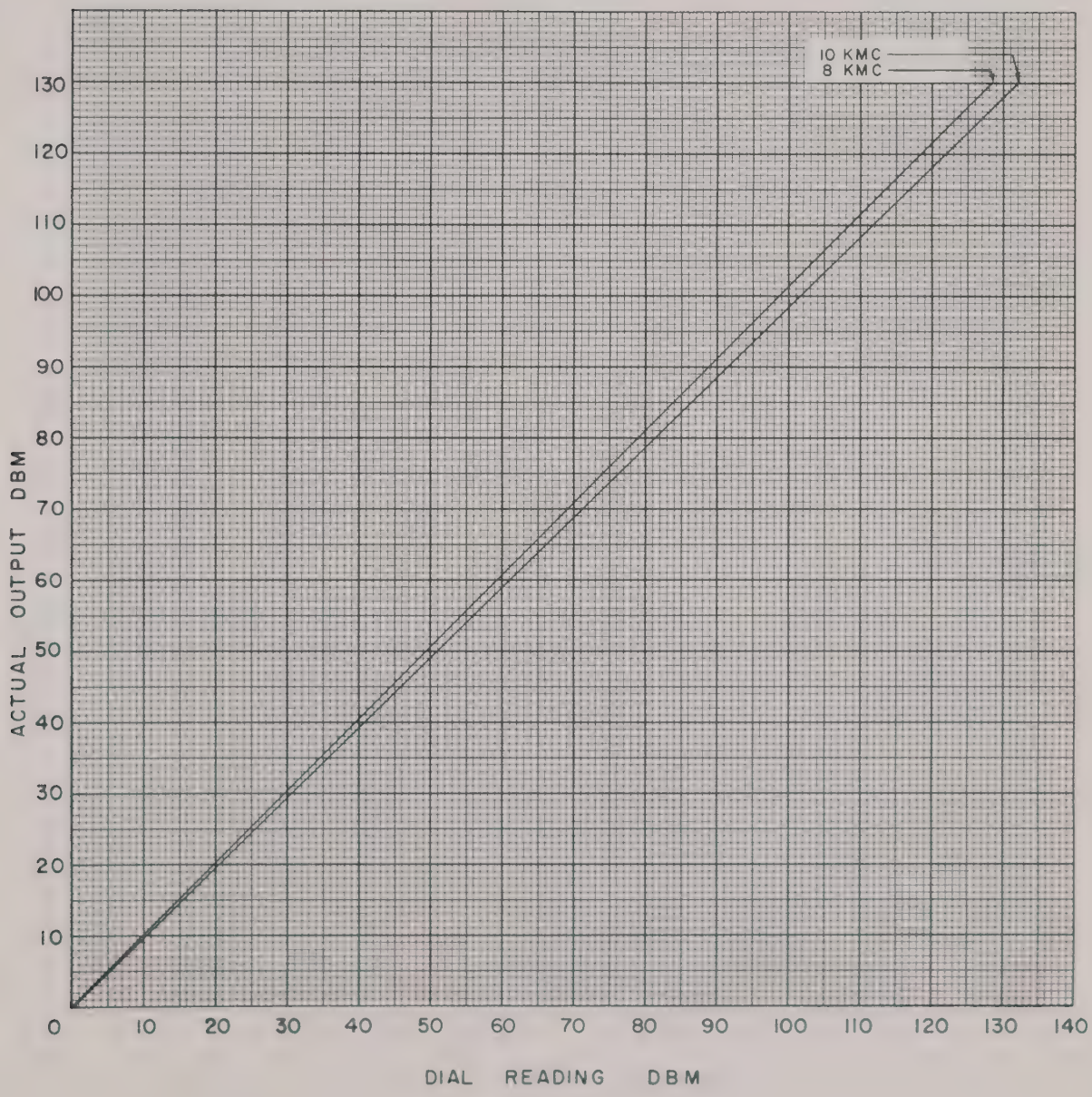


Figure 5-8. DBM Dial Correction Chart (Sheet 1)

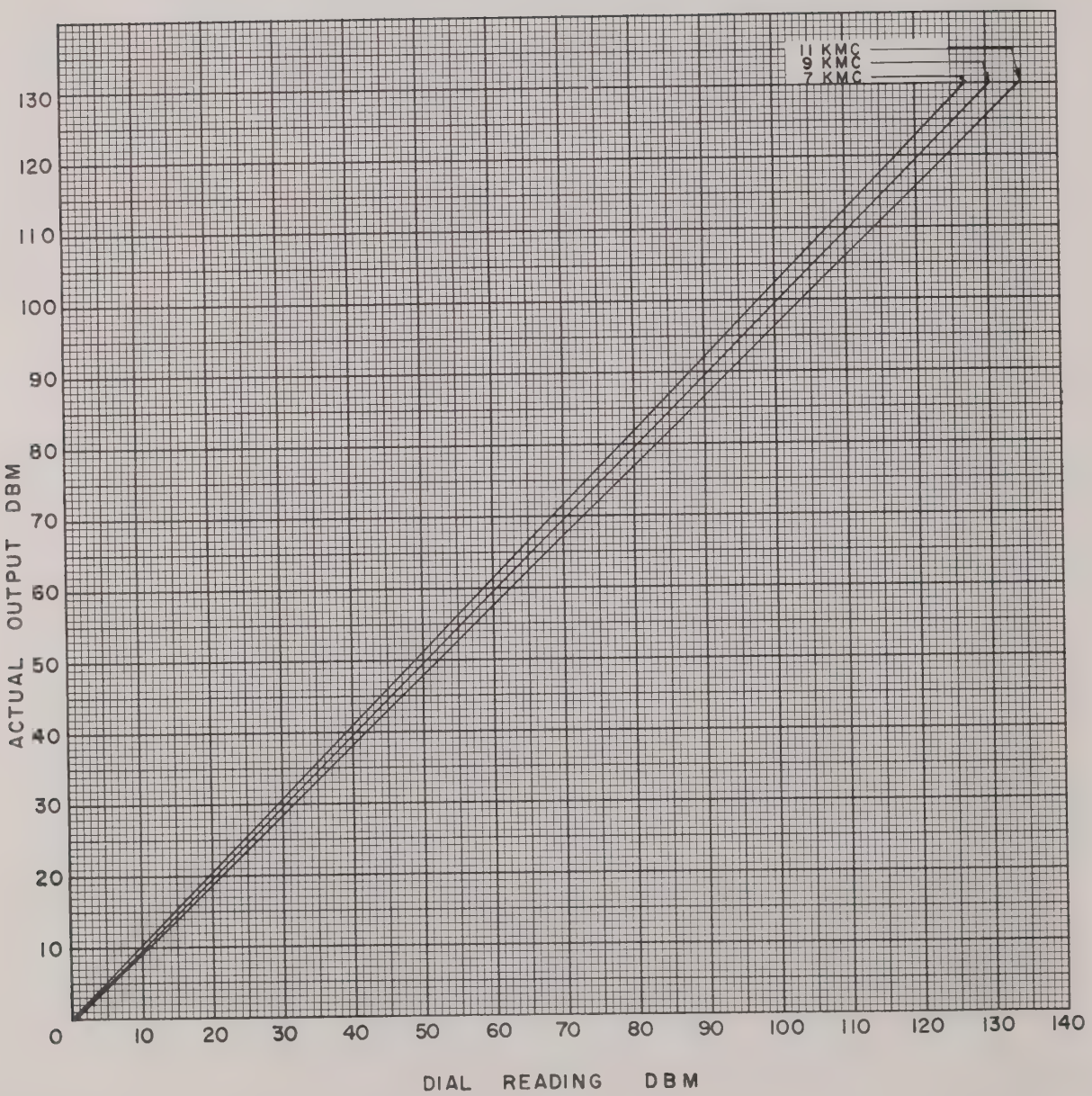


Figure 5-8. DBM Dial Correction Chart (Sheet 2)

A-1. REMOVAL OF ATTENUATOR PROBE

The following steps should be followed to remove head from main assembly.

WARNING
BEFORE REMOVING TUNING HEAD FROM MAIN CHASSIS, THE POWER ON-OFF CONTROL SHOULD BE IN OFF POSITION.

a. Remove the tuning head from the main chassis by unfastening the four screws (one in each corner of the tuning head).

b. Disconnect the following plugs and BNC connectors which will disassemble head from modulator and main assembly.

1) Plug (P1) from Jack (J1) main assembly.
2) Plug (P2) from Jack (P2) modulator.
3) BNC connectors J107 and J103 from receptacle on modulator.

c. The tuning head may now be removed from the main assembly.

A-2. The following steps should be followed to remove the Attenuator Probe from tuning head.

a. Loosen the set screws on the top collar and slide the probe out of the collar away from the cavity.

b. Remove the attenuator cable from the wire harness by unscrewing the bracket which holds the harness to the tuning head chassis. Cut the tie which holds the cable to the harness assembly.

c. Unscrew the four screws which secure the attenuator probe jack (J101 - RF OUTPUT) to the lower left hand corner of the front panel of the tuning head.

A-3. REPLACEMENT OF THE ATTENUATOR PROBE

The following procedure should be followed for the replacement of the Attenuator Probe Assembly.

a. Fasten J101 (RF OUTPUT) to the front panel of the tuning head by means of the four screws.

b. Without placing the tuning head into the basic unit, reconnect P1 to J1 and P2 to J2 (J107 and J103 need not be connected).

c. Connect an external power meter (such as the Polarad Model P-3 Power Meter and the Polarad Model TM-1 Thermistor) to the RF OUTPUT jack J101.

d. Turn the RF ATTENUATOR knob completely clockwise (insertion of gear rack and attenuator holder is maximum).

e. Apply power to the unit. The front panel POWER indicator should light. Allow a 15-minute warm-up period.

f. Set MODULATION SELECTOR control to CW. All the other dials and control knobs on the main assembly should have their pointers in an upward position.

A-4. ADJUSTING THE ATTENUATOR PROBE DEPTH

CAUTION
FOLLOW PROCEDURE CLOSELY, SINCE INSERTING PROBE IN TOO DEEPLY WILL DAMAGE THE METAL HAT IN THE CAVITY.

a. Slowly insert probe through collar, into cavity (the black dot corresponding to the ground end of probe should face the choke of the cavity - see figure A-1).

NOTE
FREQUENCY MUST BE AT LOW END AT ALL TIMES.

b. The deflection of the needle on the external power meter will follow the motion of the probe very slowly.

c. Keep inserting probe, slowly, up until the probe just touches the hat in the cavity; this will be indicated by a rapid deflection of the needle of the external power meter.

d. As soon as this indication is noted on the power meter, do not insert probe any deeper into the cavity (observe above caution), but instead back off the probe slightly away from the cavity so the power meter will read the same as before.

e. Tighten the set screws, which hold the attenuator probe in place.

A-5. REMOVAL OF THERMISTOR PROBE

The following procedure should be followed to remove tuning head from the main assembly.

WARNING
THE POWER ON-OFF CONTROL SHOULD BE IN OFF POSITION.

a. Remove the tuning head from the main assembly by unfastening the four screws (one in each corner of the tuning head).

b. Disconnect the following plugs and BNC connectors which disassemble the tuning head from modulator and main assembly:

1) Plug (P1) from jack (J1) main assembly

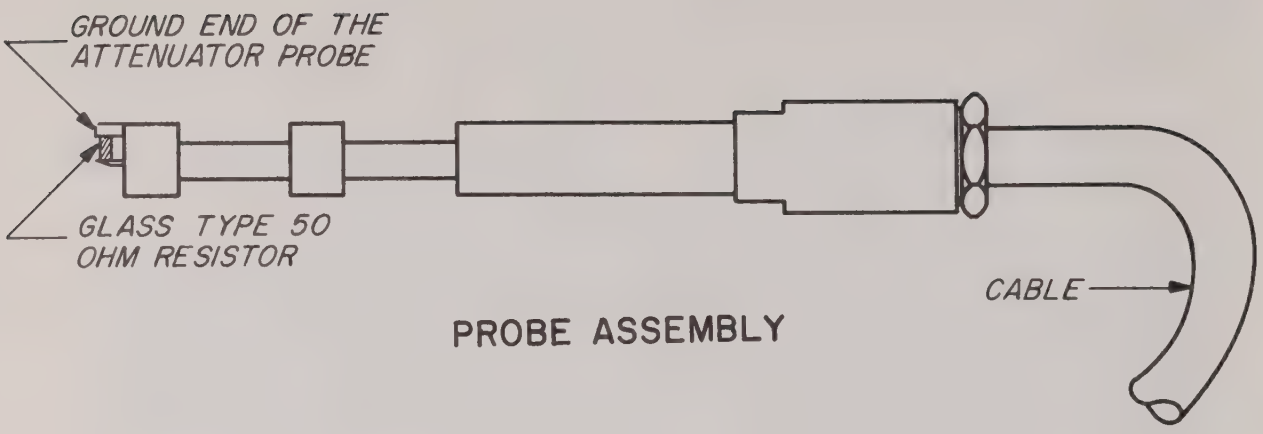


Figure A-1

2) Plug (P2) from jack (J2) modulator

3) BNC connectors J107 and J103 from receptacles on modulator

CAUTION
FREQUENCY SHOULD BE AT VERY HIGH END OF BAND AT ALL TIMES.

c. The tuning head may now be removed from main assembly.

d. Remove, from the rear of the tuning head, the tracking potentiometer protecting board by unfastening the eight screws which hold it to the tuning head chassis.

A-6. The following steps should be followed to remove the Thermistor Probe from the tuning head:

a. Unsolder the electrical connections from the cable that holds the probe. (Unsolder cable from the terminal of R115 and ground).

b. Loosen the set screws on the collar and slide the probe out of the collar away from the cavity.

A-7. REPLACEMENT OF THE THERMISTOR PROBE

The following procedure should be followed for the replacement of the Thermistor Probe Assembly:

a. Without tightening the set screws, insert the probe, through the collar, into the cavity (rear of the tuning head).

b. Solder the cable of the thermistor probe to the end of R115 which goes to the positive terminal of the POWER SET meter (M1). Solder the cable shield to the ground end of R119.

c. Without placing the tuning head into the basic unit, reconnect P1 to J1 and P2 to J2 (J107 and J103 need not be connected).

d. Set the POWER SET hairline for maximum RF OUTPUT (POWER SET knob completely clockwise).

e. Set the SIGNAL FREQUENCY dial to 11 KMC.

f. Apply power to the unit. The front panel POWER indicator should light. Allow a 15-minute warm-up period.

g. Set MODULATION SELECTOR control to CW. All the other dials and control knobs on the main assembly should have their pointers in an upward position.

A-8. ADJUSTING THE THERMISTOR PROBE DEPTH

CAUTION
FOLLOW PROCEDURE CLOSELY, SINCE INSERTING PROBE IN TOO DEEPLY WILL DAMAGE THE METAL HAT IN THE CAVITY.

a. Slowly insert probe through collar, into cavity (the black dot corresponding to the ground end of probe should face the tracking potentiometer - see figure A-2).

b. The deflection of the POWER SET meter (M1 - front panel of tuning head) will increase to full-scale as the probe is inserted.

c. Keep inserting probe, slowly, up until the probe just touches the hat in the cavity; this will be indicated by a rapid down-scale deflection of the needle of the POWER SET meter.

d. As soon as this indication is noted, do not insert

probe any deeper into the cavity (observe above caution), but instead back off the probe slightly away from the cavity so that the POWER SET meter (M1) reads the same as before.

e. Tighten the set screws, which hold the attenuator probe in place.

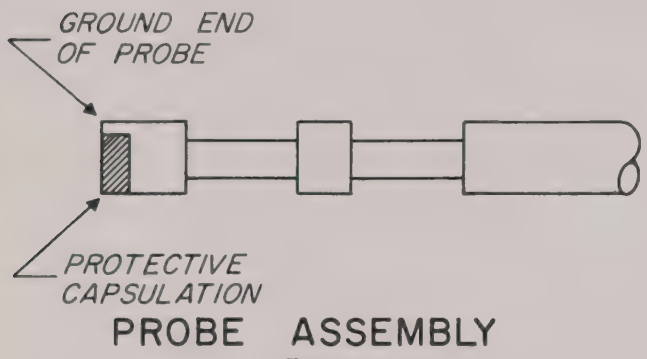


Figure A-2

A-9. RF OUTPUT CALIBRATION PROCEDURE (0 ±2 DBM)

a. Connect an external power meter (such as the Polarad Model P-3 Power Meter and the Polarad Model TM-1 Thermistor) to the RF OUTPUT jack J101.

b. Procedure for taking readings:

1) Set the MODULATION SELECTOR to ZERO SET.

2) Zero in the POWER SET meter (on front panel); then zero in the external power meter.

3) Switch the MODULATION SELECTOR to CW.

4) Set the POWER SET knob corresponding to the calibrated 1 mw output position on the POWER SET meter, M1 (needle on red line).

5) Turn the RF ATTENUATOR knob until the 0 db mark lines up with POWER SET hairline, on the ATTENUATION -DBM MICROVOLT dial (front panel of tuning head).

c. Take readings of RF POWER OUT as a function of frequency on the external power meter. From this, note the maximum and minimum power output readings and their corresponding frequencies.

d. These two readings should be symmetrical about 0 dbm; if not, make the following adjustments:

1) Remove cover from tuning head front panel.

2) Turn SIGNAL FREQUENCY dial to the frequency corresponding to the minimum power reading.

3) Obtain the 1 mw calibrated output at the RF OUTPUT jack by using the exact procedure outlined in step b.

4) Calculate the difference between the maximum and minimum power output and divide this difference by 2. This value is the new value of the minimum power out. Perform calculation in dbm units.

$$\text{new minimum reading} = \text{maximum reading} - \frac{\text{minimum reading}}{2}$$

5) Turn RF ATTENUATOR knob until the external power meter reads this new minimum value.

6) Loosen the set screws of the RF ATTENUATOR DIAL and move the dial until the 0 db mark lines up with the power set hairline. Retighten the ATTENUATOR dial set screws.

7) Replace cover on front panel of the tuning head.

e. Readings on the POWER METER should be within ±2 db of 1 mw for each setting of the SIGNAL FREQUENCY dial.

A-10. If the external power meter readings are not within the ±2 db specification, the thermistor probe ground should be shifted slightly as follows:

1) Loosen the set screws in collar

2) Turn the probe slightly so that the ground (black dot) faces in a different direction).

3) On turning the probe, make sure the needle on the POWER SET meter (M1 - front panel) stays at maximum deflection.

4) Tighten the set screws on the collar and repeat step A-9.

NOTE

If, after a number of tries (different position of the black dot on the collar of the Thermistor Probe Assembly), readings do not come within the ±2 db power specifications, the probe should be shifted in the same manner as outlined in step A-10. The r-f power output depends on the ground positions of the Thermistor Probes.

A-11. After all adjustments are made place the tracking potentiometer protecting board back on the tuning chassis and fasten the Attenuator Probe Cable to the harness assembly. Cable is fastened as follows:

a. Open the clamp which holds the harness assembly to the tuning head chassis. Place attenuator probe cable within the harness clamp. Close the clamp and refasten on to the chassis.

b. Tie the attenuator cable to the harness assembly.

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EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL _____

_____ POSITION _____

SECTION OR DIVISION _____ PHONE NO. _____ EXT. _____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

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D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

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H. Additional Comments: _____

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When trouble develops requiring factory assistance, complete this form and send to:

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43-20 34th Street
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ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

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- Direct-reading UNIDIAL® tuning —no klystron mode-setting!
- Frequency Dial Accuracy, ±1%
- Sweep-rate adjustable, 1-30 cps
- Non-contacting klystron-cavity chokes for noiseless tuning, optimum stability
- Five-inch flat-face CRT display
- Compatible with Multi-pulse Spectrum Selector SD-1

Model TSA-S
Dual-Purpose Spectrum Analyzer/ Synchroscope

TSA SERIES. 10-44,000 MC in 5 plug-in tuning units. Model TSA provides power vs. freq. display (A), below. Model TSA-S provides both (A) and synchroscope display (B). Wide-dispersion Model TSA-W provides (A) display, up to 80 MC (full screen), down to 60 KC for wide pulse analysis, as in (C).

MODEL	DISPERSION	RESOLUTION	MARKER	NOTES
TSA	25 KC-25 MC	1-80 KC	±14 MC	Sensitivity —50 to —100 dbm
TSA-S	400 KC-25 MC	5/50/500 KC and 5 MC	±14 MC	Sensitivity —50 to —100 dbm. Synch. Sweep Rates: 2 μsec to 0.1 sec/cm
TSA-W	25 KC-80 MC	1-80 KC	±40 MC	Sensitivity —50 to —100 dbm Displays spectra of 0.1 μsec pulses

Model SA-84W
Wide-Band Spectrum Analyzer

SA SERIES Universal Spectrum Analyzers provide complete coverage from 10-40,880 MC in compact, self-contained form. The new lightweight transistorized unit Model SA-84T is truly portable, and will operate from either the AC line or 12 V DC. The SA-84W wide-band design features exceptionally broad frequency coverage and very wide dispersion in a single-unit package.

Model SA-84T
Transistorized Portable

MODEL	DESCRIPTION	DISPERSION	RESOLUTION	NOTES
SA-84T	Transistorized Universal	400 KC-25 MC adjustable	20 KC	Internal Marker, ±13 MC Sensitivity, —50 to —105 dbm.
SA-84	Standard Universal	500 KC- 5 MC (up to 55 MC) 500 KC-25 MC (above 55 MC) adj.	20 KC	Variable Internal Marker comparable sensitivity to SA-84T
SA-84W	Wide-Dispersion Universal	25 KC-10 MC 25 KC-80 MC 240 to 40,880 MC	1-80 KC variable	Crystal-controlled markers over entire freq. range. Log-linear display. Accurate IF attenuator. Comparable sensitivity to SA-84T

MULTI-PULSE SPECTRUM SELECTOR: When used with any Polarad Spectrum Analyzer, this instrument permits isolation and spectrum analysis of any individual pulse in a complex coded signal.

Model SD-1

MODEL DA-70, 50-100 KMC Spectrum Analyzer. Dispersion adj. 50-1000 MC. Resolution 1 MC. High IF assures image rejection, prevents video detection. Sensitivity, —50 dbm, nom. Frequency marker for △F measurements.

MODEL WSA Wide-Band Spectrum Analyzer. 10-40,000 MC in 20 push-button-selected bands. Narrow mode: 1-25 MC dispersion, 20 KC resolution. Wide mode: 50-4,000 MC dispersion, 1.5 MC resolution. Freq. marker to 4 KMC. End-markers indicate band limits. Center-marker for wide-to-narrow switching without signal loss.

Model WSA

USE THIS CARD for complete specifications or call your local Polarad representative (see the Yellow Pages).

SIGNAL GENERATORS—0.5-50 KMC

Model PMR
UHF Signal Generator

MSG-2R
Signal Generator

Model MSG-34
Ultra-Broadband Signal Generator

500-11,000 MC SERIES. These superb instruments incorporate every important mechanical and electronic advancement known to the art, including several Polarad exclusives, such as UNIDIAL® tuning. Direct-reading frequency dials, accurate to ±1%. High-stability non-contacting klystron-cavity shorts for noiseless tuning, permanent accuracy. Continuously-variable, directly-calibrated attenuators. Modulation: internal pulse, FM, sq-wave; external pulse and multi-pulse. Delayed and undelayed sync. outputs. The Model PMR provides exceptional FM capability through the use of a special plug-in modulator (supplied).

MODEL	FREQUENCY-KMC	CALIBRATED POWER OUTPUT	INTERNAL MODULATION
PMR	0.5 - 1.0	0.5 MW (—3 dbm) to —127 dbm	sq-wave, 40-4,000 pps } FM with plug-in Pulse, 10-10,000 pps } modulator
KSS (Signal Source)	1.05-11.0 (4 plug-ins)	Uncalibrated. Power Output: 14-400 MW, depending on freq.	sq-wave, 10-10,000 pps (external pulse, sq-wave, FM)
PMX	4.45-11.0 (2 plug-ins)	1 MW (0 dbm) to —127 dbm	All instruments in this group: pulse modulation: 10-10,000 pps. *pulse width: 0.2-10 μsec. pulse delay: 2-2,000 μsec. square-wave modulation: 10-10,000 pps. FM deviation: ±2.5 MC min. *0.3-10 μsec. in MSG-1R and 2R.
MSG-34 (Ultra Broadband)	4.2 -11.0 digital freq. indicator	1 MW (0 dbm) to —127 dbm	
MSG-1R	0.95- 2.40	1 MW (0 dbm) to —127 dbm	
MSG-2R	2.0 - 4.60	1 MW (0 dbm) to —127 dbm	

MULTI-PULSE CODE-MODULATED MICROWAVE SIGNAL GENERATOR

Model B — 0.95 to 10.75 KMC 4 plug-in tuning units. 5 independent adjustable channels, each with variable pulse width and delay. Built-in precision scope.

EHF SERIES Signal Generators (frequency and power calibrated) and Signal Sources (frequency calibrated) operate CW, with 1 KC int. modulation, or ext. mod'n. See chart for tuning unit ranges and designations. Also available: SG-1218 Generator or SS-1218 Source, 12.4-17.5 KMC.

EHF Series
Signal Generators

EHF SIGNAL GENERATOR Tuning Unit	Frequency Range	EHF SIGNAL SOURCE Tuning Unit
G1822-1	18,000 to 22,000 mc	S1822-1
G2225-1	22,000 to 25,000 mc	S2225-1
G2427-1	24,700 to 27,500 mc	S2427-1
G2730-1	27,270 to 30,000 mc	S2730-1
G3033-1	29,700 to 33,520 mc	S2933-1
G3336-1	33,520 to 36,250 mc	S3336-1
G3540-1	35,100 to 39,700 mc	S3540-1
	39,600 to 46,000 mc	S4046-1
	45,900 to 50,000 mc	S4650-1

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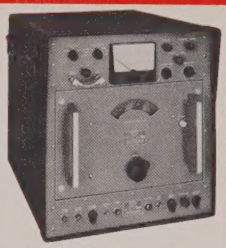
Model CFI Portable Transistorized Calibrated RI/FI — Meter/Receiver



Model R Wide-Range Multipurpose Microwave Receiver

Model FIM-2 Absolute-Calibrated RI/FI—Meter/Receiver

Model TR Transistorized Portable Wide-Range Multipurpose Receiver

Both the CFI and FIM-2 have Category A Air-Force Approval Per MIL-I-26600 and MIL-I-6181

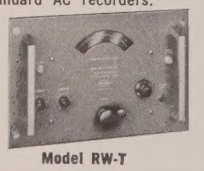
MODEL	DESCRIPTION	FREQUENCY RANGE	MINIMUM SENSITIVITY ⑥	SELECTIVITY & TUNING (see notes below)	CHARACTERISTICS
CFI	TRANSISTORIZED CALIBRATED RI/FI METER/RECEIVER (Category A AF approved)	1-10 KMC (0.95-11.26 as receiver)	—90 to —84 dbm	① ② ③ ④	• **Digital** frequency dial • AM, FM, CW, Pulse reception • AFC, AGC (60 db linearity range!)
FIM-2	CALIBRATED RI/FI METER/RECEIVER (Category A AF approved)	1-10 KMC Check Polarad for 21 KMC Coverage.	—81 dbm	① ② ③ ④	• Single UNIDIAL® tunes both receiver and signal generator. • First system to determine radiated RF interference and susceptibility.
TR	TRANSISTORIZED MICROWAVE RECEIVER	0.95-11.26 KMC	—90 dbm	① ③ ④ ⑤	• AFC, AGC circuits. • **Digital** frequency dial • AFC, AGC (60 db linearity range!)
R	ULTRA-WIDE-BAND MICROWAVE RECEIVER	0.4-84.2 KMC	—85 to —50 dbm	② ③ ⑤	• UNIDIAL® direct-reading freq. control • AFC, AGC (60 db linearity range!)

• Calibrated antenna system includes both omni (broad-band) and directionals for each range.
• Attenuation: 0-80 db in 1 db steps
• Front panel metering of average, peak, slide-back peak, or quasi-peak RF level.

These versatile precision devices are really **four instruments in one:**
• AM, FM, CW, MCW, Pulse Receiver.
• Field-intensity receiver.
• Pulse, pulse-time position demodulator.
• Sensitive power meter.

① Impulse Bandwidth: 1, 5, or 8 mc (Model FIM-2, 5MC only).
② Image and Spurious Response Rejection: better than 60 db. (up to 11.26 KMC in Model R)
③ Four plug-in tuning units cover entire range (Model R uses 9) and all are direct-reading, calibrated to ±1%.
④ Maximum RF input, 3 Volts.
⑤ Video bandwidth: 3.5 MC (Model TR) 2 MC (Model R)
⑥ Depending upon frequency.

ANTENNA PATTERN TUNING UNIT 2-75 KMC: Used with Model R receiver. External Mixer with flexible cable. Locate up to 75 ft. from receiver, at or near antenna. Internal 1 KC sweep — compatible with all standard AC recorders.



Model RW-T

CALIBRATED ANTENNAS
1,000 to 10,000 MC

TEST ANTENNAS
1,000 to 40,000 MC

TRANSISTORIZED IMPULSE GENERATOR Model IC-120: 1 MC-10 KMC. Calibrates microwave receivers for RI/FI work. Signal source for spectrum analyzers. Generates 0.02 nanosec. pulses.

ALL-CERAMIC REFLEX KLYSTRONS Maximum resistance to shock, vibration, temperature extremes. Guaranteed operation to 250°C, without cooling. Stable, low noise, low microphonics. (X series has guaranteed minimum 200 mw output.) Request complete application data.

TYPE	FREQ. RANGE—KMC	RETMA
ZV1012	0.5 - 3.0	7506
ZV1010	0.7 - 3.0	7505
ZV1010X	0.95- 2.8	——
ZV1021	1.0 - 4.0	——
ZV1021X	1.0 - 4.0	——
ZV1009	1.5 - 6.0	7049
ZV1009X	1.7 - 5.0	——
ZV1011	4.0 -11.0	8052

BG-678

I would like more information and specifications on: (circle)

SPECTRUM ANALYZERS
TSA SA-84 DA-70
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SIGNAL GENERATORS
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MSG-34 MSG-2R KSS
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RECEIVERS and RI/FI METERS
R RW-T CFI
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CODED MULTI-PULSE GENERATOR—Model MP-1A. Five independently adjustable channels generate coded multipulse trains. Permits independent external PTM of each channel. 10-10,000 cps group rep-rate, each pulse adj. 0.2-2 μsec. Delay, 0-300 μsec.

PULSE JITTER TESTER. Model PJ-1 Measures and displays magnitude and waveform of:
Relative jitter: 5/10/100 nanosec. full scale
Pulse-width jitter: 5/10/100 nanosec full scale
Rep-rate jitter: 5/10/100 nanosec, 1 10/100 μsec. full scale

PRECISION NOISE GENERATOR. Model N-1. 1KC-500MC source for direct measurement of noise figure (1-20 db, accurate to ±0.25 db) of VT and transistor circuits.

TRANSISTORIZED MICROWAVE POWER METER. Model P-3. Measures absolute power instantly, directly, 10-40,000 MC with 5 interchangeable thermistor mounts. 0.01 MW full scale sensitivity. Line or battery operated, only 6 lbs.

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W & K McLean, Ltd.
7 Anzac Avenue
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NORWAY

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Tellbodgt 4
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PERU

V. M. LaPierre & Cia.
Los Alamos 375
San Isidro, Lima

PHILIPPINES

Radio Electronic Headquarters, In
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PORTUGAL

Equipamentos de
Laboratoria, Lda.
Apartado 458
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SOUTH AFRICA

Leigh & Hurwitz (Pty) Ltd.
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Johannesburg

SWEDEN

Gunnar Petterson
Ostmarksgatan 31
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SWITZERLAND

Omni Ray AG
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VENEZUELA

Venelectronica
Apartado 10827
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